The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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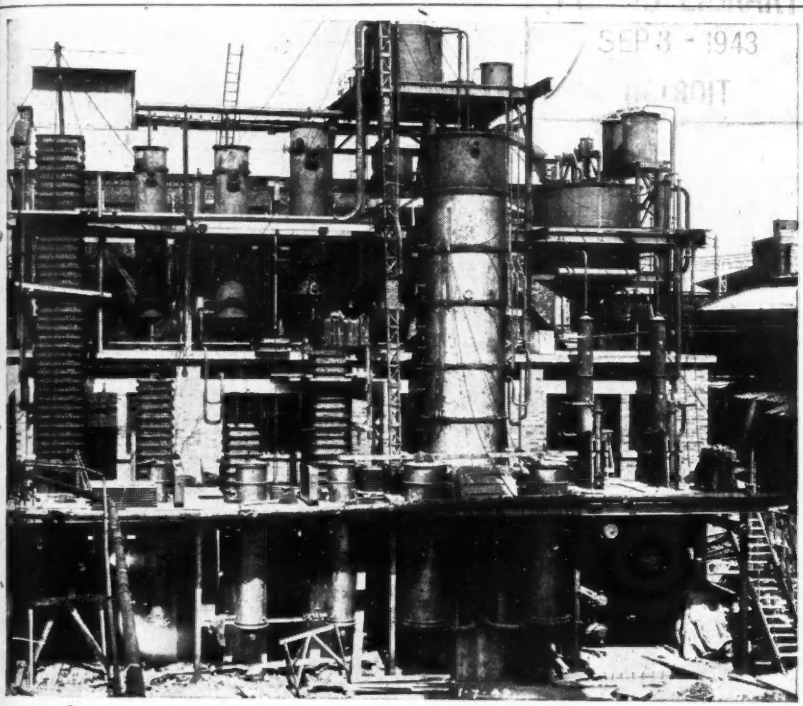

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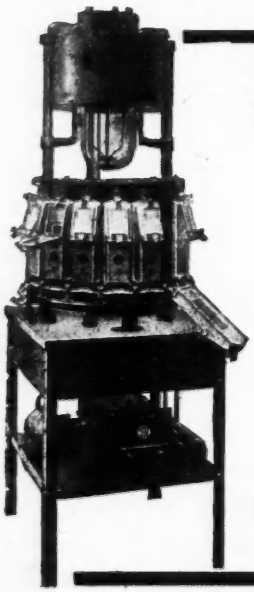

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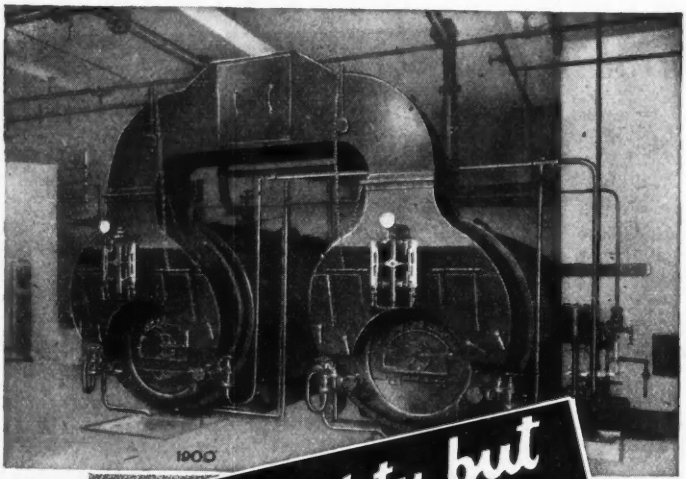

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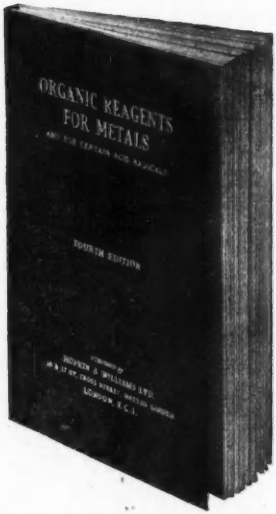

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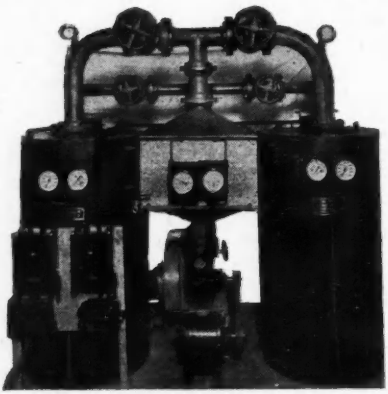

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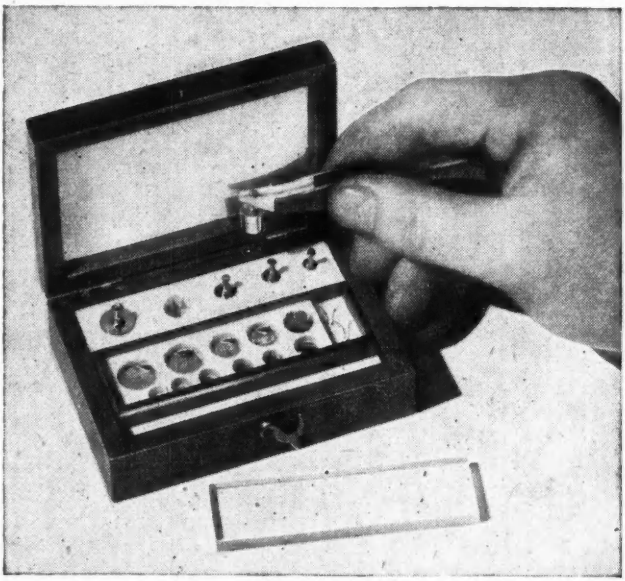

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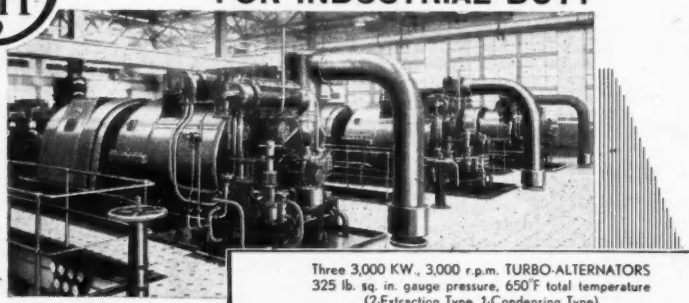

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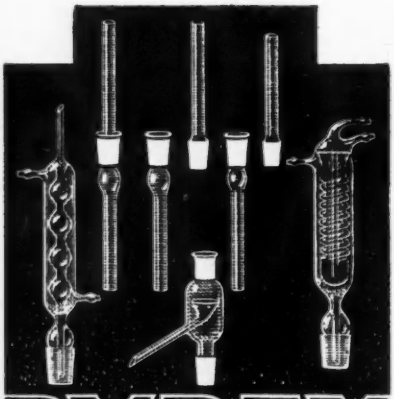

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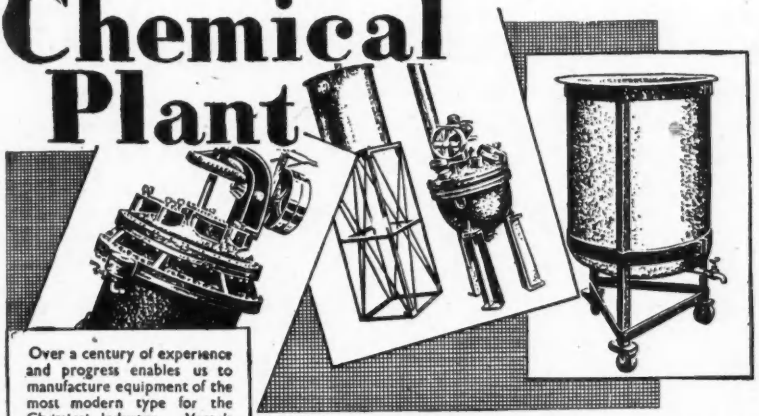

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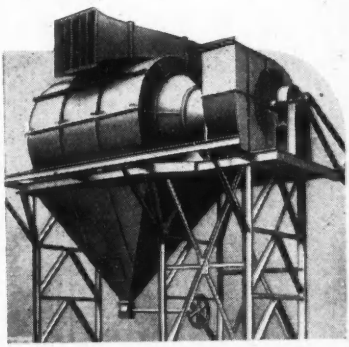

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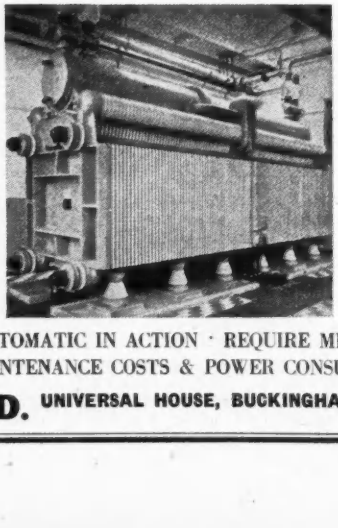

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Changing Ideas

RIGIDITY in ideas is one of the major stumbling blocks of progress. "If it is not necessary to change," said a famous statesman of a bygone age, "it is necessary not to change." That may or may not be a good maxim for the politician and the statesman; it is from their angle the antithesis of the restlessness that affects most generations early or late: "Quietness, grown sick of rest, would purge by any desperate change." But in this year of grace each of us must search his mind to discover how far change is, in fact, necessary. The tempo of life changes in each generation, and that change is due to science and to the impact of science upon commercial life. Mankind has probably been on this earth for several million years. Jeans puts 5000 years as the period during which facts have been recorded. The recording of facts enabled each generation to start with the accumulated knowledge and experience of its forefathers — though not necessarily with the wisdom that comes from that experience. Science began to make conscious headway about 300 to 400 years ago and its impact on industry is of much more recent growth. As such knowledge increases, and as more and more men become trained to use it or to take advantage of the services of those who can use science as a tool in the service of mankind, the tempo of change increases. Thus the events of this present century have left us all a little breathless.

The change that we have experienced does not concern only the increase of knowledge. It is also a change in the application of knowledge. Nor does it concern only the technique of manufacturing goods or of conducting researches: it concerns still more vitally our outlook upon human affairs. The "change and decay" of the hymnologist has given place to "change and progress." We may make mistakes in our changes, but we can retrace our footsteps if need be, and in the main the result has been one of rapid progress. Examples of this may be quoted and of the differences in opinion that it may give rise to. Trade Associations have been known for a great many centuries in one form or another, but the ancient guilds—which partook to some extent of the nature of the modern Trade Union, and of "closed shop policy"—have given place to something quite different. When the industrial age came upon us, each man had to discover how best to make the goods

On Other Pages

Notes and Comments 125
Petroleum War Developments ... 127
The Importance of Manganese ... 133
Letter to the Editor 136
Fertilisers in Scotland 137
Parliamenary Topics 137
Personal Notes 138
Production-Planning Courses ... 138
New Type of Insulin 138

METALLURGICAL SECTION

The Casting of Brass 139
The Longhorn Tin Smelter ... 142
Brazil's Bauxite Deposits ... 142
The Metallurgy of Antimony ... 143
Fabricating Steel Slabs ... 144
Metallurgical Progress in Peru 144

General News from Week to Week 145
Commercial Intelligence ... 146
Stocks and Shares 147
British Chemical Prices 148

that he set out to manufacture. The knowledge so gained was hardly won, at the cost of much toil and often of loss, until ultimately the manufacturer succeeded in establishing himself in business. It is quite natural that in these circumstances a tradition of secrecy should have arisen. The manufacturer did not want others to use the experience and knowledge for which he had paid so dearly, and with the individualistic system of trading, co-operation was the last thing that was encouraged. The events of this present century have shown us that science has rendered secrecy not only unnecessary but positively dangerous. What are thought to be secrets can be discovered with but little difficulty by the research worker, and improvements are made with an ease which must be disconcerting to those who have so jealously guarded their little store of knowledge for so long.

Again, powerful groups of manufacturers of the past generation agreed together to demand prices in excess of those that they could procure by unrestricted competition, and the American "trusts" were evolved. The bad influence of artificial raising of prices above an economic level for private profit has remained in men's minds so that price-fixing cartels are regarded by the uninformed with suspicion. So long as supply lagged behind demand, prices would naturally be high enough to provide the manufacturer with adequate returns, and price-fixing arrangements were both unnecessary and unsocial. But as soon as the onward march of science and machinery began to put the possibilities of mass production, or (on a lower scale) of greatly increased production per man employed, within the powers of industry, plant and employees could not be fully occupied, overheads crept up, and the tendency was for manufacturers to compete in a Dutch Auction. The result was inevitably disastrous until the hitherto secretive and individualistic employers decided to take action to restrict production by mutual arrangements, and to regulate prices. At first this was done in a highly secretive manner as befitting past traditions, but now there is no secret about it. It is done openly, and it should be done openly. Prices must be fixed so that the manufacturer can: (1) pay his men a reasonable wage, (2) pay a reasonable return on the capital he employs, and (3) engage in whatever research or development work the nature of his business requires. But prices should be, and are, regulated so that the consumer pays a fair, but not an excessive price. Progress in market research and in economics has led to the realisation that high profits and high prices are not the path to prosperity. Again we have changed our views fundamentally.

It is hard for many to adjust their ideas to the needs of the times. There are those who find that the new spirit of co-operation between firms that once were rivals is against all tradition and experience. It is not surprising if they hesitate to join the movements that are characteristic of our generation. Either they will do so, however, or they will be swept away. Let us, at least, be sure that those who are in control of British industry are able to move with the times and are prepared to adapt themselves to the new conditions. We hope to see collaboration between the nations of the world in respect to post-war trade. It may not work out that way, but if it does, it means that each nation will function to some extent as an entity, and that therefore there must be co-operation between all firms in any one industry. If international co-operation does not materialise it is perhaps equally important in principle and even more essential in fact that the fullest co-operation between all sections of British industry and between all units in the one industry should come into being. Some agree to co-operation in principle, but with such reservations as to make their acceptance of little practical value. That there will be divergent ideas as to how trade associations should function is self-evident, but the view must prevail, if we are to survive in the present industrial age, that we shall so model our industrial organisation that we may secure reasonable profits, plants of the highest technical standard, and full employment for our people. Post-war planning is in the air, throughout the nation, and equally throughout the chemical industry. Let us make sure that those at the head of affairs are fitted to handle this important problem.

NOTES AND COMMENTS

Rayon Research

THE British Rayon Federation—the foundation of which was announced in our columns a few weeks ago—has got away to a good start. At its first meeting, held on July 28, the president, Mr. Samuel Courtauld, stated, in no uncertain terms, the policy and aims of the Federation. His remarks on research, in particular, are of the highest interest; in common with other technical industrial organisations, the rayon trade has found that there is much wrong with our research systems and much leeway to be made up. Mr. Courtauld goes straight to the root of the matter when he urges that State expenditure on research should be expanded on a scale which he describes as "revolutionary," and that private research should be aided by the remission of fiscal burdens. This is no mere subsidy, it is pointed out, but a good investment. It is proposed to set up before very long "an ample and first-class research institute" to assist each branch of the rayon industry, and the problems covered will comprise not only the nature and behaviour of rayon fibres themselves, but also the design of plant and machinery.

Training Textile Technicians

MR. COURTAULD ranges himself among the large body of industrialists who believe that "England has rested far too long upon her oars, and that other countries have gone ahead of us in many technical fields." To redress the balance it is essential to put money into research as liberally as circumstances allow, as well as to convince the Government that such expenditure is a sound business investment. A training centre for advanced students selected from the various textile schools, either embodied in or closely connected with the proposed research institute, is another of Mr. Courtauld's suggestions, with the aim of producing a type of technician who "combines the old practical virtues with the new scientific method and outlook"—a sound point, this. Detailed recommendations include a delegation of mechinery experts to visit America to study transatlantic methods on the spot, and a series of lectures by the best processors, weavers, and finishers, if such men are willing to give their services. "At this moment," said Mr. Courtauld, "the wheel of time is giving the rayon industry the chance of filling a historic mission—of furnishing the manufacturing genius of our people with a fresh opportunity of putting England right in the van of textile progress."

Flotation and Tin Ores

IN his presidential address to the Society of Chemical Industry, Dr. William Cullen, after describing the flotation process as "perhaps the most outstanding advance" made in the mining industry in recent years, mentioned that it could not be applied economically to tin, one of our few indigenous non-ferrous metallurgical industries. This particular point was elaborated into a "leader" in a recent number of the Australian paper, *Chemical Engineering and Mining Review*, which calls attention to the fact that the problem of concentrating not only cassiterite but also wolframite has so far resisted all efforts towards a satisfactory solution by flotation. The value of these ores to modern industry is so great and their distribution so limited and erratic that the minerals are almost entitled to be classed as semi-precious. Yet their recovery from the lode matter by milling is, except in rare cases where the valuable particles are coarse and easily liberated, notoriously low. In the majority of mills the recovery of tin and tungstic acid will be found to lie between 40 per cent. and 60 per cent. of the original content of the ore. The reason for this high loss is the brittleness of cassiterite, wolframite and scheelite, and the consequent production of a large proportion of slime in the liberation of the mineral from the less easily crushed gangue.

A Field for Research

THE writer in *Chemical Engineering* goes on to say that in the recovery of the high percentage of valuable mineral now lost in mill slimes lies the field for flotation research. He adds: "The problem has been investigated by a number of metallurgists and some progress has been made, particularly with scheelite. With existing reagents and technique, however, much gangue is floated at the same time, and the resulting concentrate is too low in the desired

mineral to be acceptable to buyers. In existing practice, this flotation concentrate can be redressed only by gravity methods, limited to special slime concentrating tables, and other machinery; and the work done is very inefficient, with abnormally high losses. The problem is, in fact, beyond the sphere of gravity concentration. Such problems, which have characterised the treatment of metallic sulphides, have been solved, stage by stage, by flotation. The need for tin and tungsten ores is now more urgent and solution of the recovery problem will be a major metallurgical achievement, and an important contribution to the war effort. Flotation appears to be the medium, assisted perhaps by some method of agglomeration, whereby final redressing would be materially assisted."

New Chemicals for Widnes?

THE town of Widnes, in South Lancashire, has for many years been closely associated with the chemical industry, and to-day it is working, probably harder than ever before, at many of the processes with which the industry is concerned. However, to judge by the words of Mr. J. Carney, writing in the *Widnes Weekly News* this week, those in charge of the town's well-being are not doing their full share in ensuring that Widnes shall continue to play an important part in the chemical industry of the future. The chemical industry is changing rapidly, and Mr. Carney is fully justified in saying that there are many chemical processes now operating in Widnes which will be closed down after the war. It is evidently the duty of the Town Council to see that these are replaced by others of a nature consistent with the modernisation of the industry. The men of Widnes have long laboured in the chemical field; they remember the hard days when there was no beauty in the industry, when there was nothing to return home to but a pall of gas hanging over their dwellings. Speaking of his home town Mr. Carney writes: "I have seen its old men, broken in health, earning a few shillings breaking pyrites into small lumps. I have seen men risk their health and lives beside black ash revolvers. I have seen them go muzzled into the old-fashioned bleaching-powder chambers." This sort of thing is happily of the past, but it is not impossible to foresee distress assailing Widnes in the future if due provision is not made for the chemical industry that is to come. Mr. Carney suggests that an industrial survey of the town should be undertaken with a view to attracting the newer branches of the chemical industry. He cites bauxite and plastics as examples of the kind of industry he has in mind. Other places, he sees, are applying the magic of modern chemistry and metallurgy to these substances—why not the cradle of the British chemical industry?

Lord McGowan on Cartels

FOLLOWING his explanation in the House of Lords of I.C.I.'s part in the international chemical cartel, Lord McGowan has elaborated on the subject of combines and cartels in an article in the *Sunday Times*. After remarking that the element of competition must be present in every healthy economy, he maintains that there are few to-day who would recommend a return to unrestricted competition as the *basis* for our economy, either at home or in export markets. The alternative road leads inevitably to amalgamation and cartels. He finds that the benefits which the community has derived directly from the large-scale unit are as considerable as they are indisputable; it has enormously increased production and reduced prices. Being able to make fuller use of research, it can improve old products and evolve new ones. In the labour field, says Lord McGowan, it has improved the conditions in which its employees work and has greatly increased the overall degree of security of employment. It has tended to stabilise dividends and thus ensured shareholders a fair return on their capital while reducing opportunities for speculation. Of the part that great combines have played during the war, he says: "I am confident that but for the existence of these large-scale, organised industries we should have been in a sorry plight indeed. . . . I say definitely that, had I.C.I. not been formed, Great Britain would before this war have been a second-class power to Germany and the U.S.A. in the production of the heavy chemicals on which our national existence depends."

Petroleum War Developments*

Cracking and the Fluid Catalyst

by E. V. MURPHREE

THE petroleum industry's contributions to the war effort have been numerous and varied. Undoubtedly, the most important of its contributions along manufacturing lines are the production of synthetic toluene, of large quantities of high-octane aviation petrol, and of raw materials for synthetic rubber. These processes give either pure chemical compounds or mixtures of definite types of chemical compounds and, therefore, represent organic chemical synthesis on an enormous scale.

Table I gives an over-all picture of the new process developments and their relation to oil refining. A typical crude oil is broken down into various fractions which are then processed to obtain the products used in high-octane aviation petrol or synthetic rubber raw materials. Table I shows that the C_4 fraction can be converted into aviation petrol through the alkylation process, using fractionation or isomerisation or both. As an alternative, the butane fraction after separation of isobutane can be catalytically dehydrogenated by successive steps to give butadiene. The C_5, C_6, and C_7 fractions (boiling up to 200° F.) can be used directly in aviation petrol, or selected fractions of these cuts can be isolated by fractionation and used in aviation petrol. The low octane number fractions discarded in the fractionation can be isomerised into fractions of higher octane number. The fraction boiling from 200° to 290° F. contains most of the potential as well as the actual C_7 and C_8 aromatic compounds, such as toluene and the xylenes. This fraction is preferably processed by hydroforming to convert potential aromatics into actual aromatics; the hydroformed material can be used directly in aviation petrol, or the aromatics can be isolated by extraction. The heavy naphtha boiling from 290° to 350° F. can be subjected to severe thermal cracking or reforming to yield butadiene and other desirable materials directly, or this fraction can be hydroformed. The gas oil fraction boiling from 350° F. to crude bottoms is best processed by catalytic cracking to yield aviation petrol and raw materials for synthetic rubber. The lighter portion of this fraction can be subjected to severe thermal cracking to yield butadiene and other desirable products. The crude bottoms can be utilised in fuel oil.

Most of the processes indicated in Table I represent new tools developed in the last few years, and many of them are recent developments just now beginning to be applied. The vast amount of new equipment being installed for carrying out these processes represents an investment of nearly a billion dollars.

Superfractionation

Distillation is the oldest process for separating petroleum into its constituents. Application of fractional distillation to give extremely narrow-cut fractions is, however, a commercial development of rather recent application in petroleum refining and has been termed "superfractionation." By careful analysis of the lighter fraction of crude oil it has been found that certain constituents, particularly the iso- or branched-chain compounds, have higher octane number or anti-knock properties than others. Furthermore, isobutane is one of the raw materials for the alkylation process. Fractionation is applied for isolating isobutane from the C_4 fraction. Isopentane has a considerably higher octane number than *n*-pentane and is therefore being isolated in many cases by fractionation from the C_5 fraction.

Alkylation

Alkylation is a process of relatively recent origin by which isoparaffins are combined with olefines to give higher molecular weight compounds of branched-chain structure. From a commercial standpoint the isoparaffin used is isobutane which can be combined with propylene or C_4 or C_5 olefines. The reactions involved, the major products obtained, and the octane number of part of the product known as aviation alkylate which can be used in aviation petrol are shown in Table II. A catalyst is used in the alkylation reaction; for the C_3, C_4, and C_5 olefines, sulphuric acid or hydrofluoric acid may be employed.

In a typical alkylation process the fresh feed consisting of isobutane and C_4 olefines, which may contain some *n*-butane, is introduced into a reaction medium consisting of an emulsion of hydrocarbon and sulphuric acid. This emulsion circulates continuously through a reactor and then through a heat exchanger to remove the heat of reaction. Hydrocarbon fraction roughly equivalent in volume to the feed is drawn off to a fractionation system which separates the isobutane and returns it to the reaction system. The *n*-butane introduced with the feed is discarded, and the alkylate produced is separated from a small amount of polymer of higher molecular weight.

Alkylation is carried out on a large scale

* Abstracted from *Ind. Eng. Chem.*, (1943, **35**, 6, p. 623).

TABLE I. PROCESSING OF CRUDE OIL

Fraction	% on Crude	Processes Used	End Use
Gas	0.7	Direct	Fuel
C_4	1.7	Fractionation, Isomerisation, Alkylation	Aviation petrol
		Dehydrogenation	Butadiene
C_5	2.6	Direct	Aviation petrol
C_6	3.0	Fractionation	
C_7 (200° F.)	4.3	Isomerisation	
200°–290° F.	11.2	Direct	Aviation petrol
		Hydroforming	Synthetic aromatics
290°–350° F.	7.0	Severe thermal cracking	Butadiene
350° F., crude bottoms	57.5	Catalytic cracking	Aviation petrol
		Severe thermal cracking	Butadiene, Isobutylene for Butyl rubber

to-day for production of high-octane petrol blending agent. The isobutane required is fractionated from the butane fraction in crude oil production or in refining operations, or produced by isomerisation of the *n*-butane obtained in this way. The olefines used as raw material for alkylation are obtained from cracking.

Isomerisation

Isomerisation involves rearrangement of a compound without change in molecular weight, and its most important commercial application in the petroleum field is the conversion of *n*-butane to isobutane, this reaction being carried out normally with aluminium chloride as catalyst. Owing to equilibrium limitations, only part of the *n*-butane is converted to isobutane per pass. The isobutane obtained can either be isolated by fractionation or directly fed to an alkylation process. By combining isomerisation of *n*-butane with alkylation, some saving is achieved by the use of common fractionation equipment.

C_5 and higher straight-chain hydrocarbons can be isomerised to branched-chain hydrocarbons; this treatment improves their anti-knock properties. Isopentane, isohexane, and isoheptane are valuable compounds for use in high-octane aviation petrol. In the case of the C_5 and higher hydrocarbons, there is a tendency for cracking to occur during isomerisation, and the olefines produced form complexes with the aluminium chloride. These complexes are very active, particularly for cracking, but have little selectivity for isomerisation. For this reason it is desirable to carry out the isomerisation of the C_5 and higher hydrocarbons under conditions where the olefine complexes are suppressed.

Hydroforming

Catalytic dehydrogenation is effective for converting C_6 and higher normal paraffins and six-carbon ring naphthenes into aromatics. When applied to fractions of naphtha from crude, catalytic dehydrogenation yields large quantities not only of aromatics but also of coke, and the cost of equipment involved in burning off coke from the catalyst is high. To decrease coke formation, dehydrogenation is carried out under hydrogen partial pressure. This operation, involving catalytic dehydrogenation in the presence of hydrogen, is known as hydroforming.

Hydroforming produces aromatics primarily by dehydrogenation of C_6 naphthenes and is not effective for obtaining aromatics from paraffins. As an example, toluene is produced by dehydrogenation of methylcyclohexane; xylenes are obtained by catalytic dehydrogenation of dimethylcyclohexane (see Fig. 1).

In addition, certain amounts of toluene and xylenes may be produced by cracking higher alkylated aromatics, either present in the feed or produced during hydroforming. There is also some formation of aromatics from alkylated C_5 naphthenes which presumably are first isomerised into C_6 naphthenes. The first major war-time application of hydroforming has been to produce synthetic toluene for TNT. The first commercial plant, which has been in operation for a considerable time, is making toluene at a rate equivalent to about twice that produced by the whole coal-tar industry. Without the hydroforming process, America would be in a serious position in regard to toluene supplies. Additional plants for synthetic toluene have been installed. When the proper naphtha fraction is used, the hydroforming process will produce high quality aviation petrol and will probably be widely utilised for this purpose.

Catalytic Cracking

Cracking has been described as a process for making little ones from big ones—that is, for converting higher into lower molecular weight hydrocarbons. It can be accomplished by heat alone (thermal cracking) or by the action of a catalyst under conditions which give negligible thermal cracking (catalytic cracking). The catalyst

not only accelerates but also directs the course of the cracking reaction to give better yields of higher quality products. During the course of a cracking reaction, the catalyst becomes fouled and must be revivified by removal of the tar or coke by burning with air. Three types of catalytic cracking are being widely applied—the Houdry, the Fluid Catalyst, and the Thermofor processes.

The Houdry process utilises the conventional fixed-bed principle. Oil vapour is passed through a fixed catalyst bed where cracking occurs. The cracked products are separated into desired constituents by fractionation. After cracking has been carried

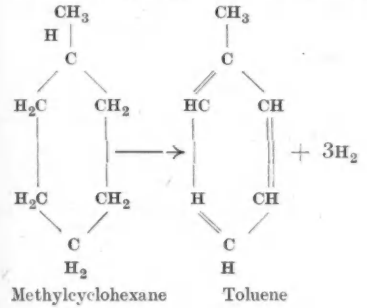


Fig. 1.

out for a certain time in one reactor, the oil vapour stream is switched to another reactor while the first reactor is regenerated by burning the coke off the catalyst with air. Generally several reactors are used. By switching the oil vapour stream from one reactor to another, cracking is continuous. The reactors are treated intermittently through alternate cycles of cracking and regeneration.

In the Fluid Catalyst and Thermofor processes, catalyst is continuously circulated through a reaction vessel, then to a regeneration vessel, and back to the reaction vessel. These processes are truly continuous. The Thermofor process uses catalyst in the form of coarse granules and mechanical conveyors for circulation. In the Fluid Catalyst process, circulation is accomplished by principles not previously applied commercially. In both processes, oil normally in the form of vapour is passed through the reactor where cracking occurs, and cracked products are sent to suitable fractionation equipment. Air is blown through the regenerator for burning the coke deposited on the catalyst. Both the Houdry and Thermofor processes have already been discussed rather fully.[1,2]

The Fluid Catalyst operation represents a new industrial method of handling solids and of controlling the temperatures of gaseous or vapour reactions. The catalyst is used in the form of powder, maintained in a free-flowing or fluid condition at all times. Circulation of catalyst in large quantities between the reaction or cracking vessel and the regeneration vessel is accomplished without moving parts, by application of the gas lift principle for handling liquids. Pressure to promote catalyst circulation is built up by a standpipe containing catalyst of high density which provides a gravity fluid head against a catalyst leg of lower density. The amount of pressure that can be built up depends only on the height of the standpipe. Fig. 2 gives a flow sheet of one type of design for a fluid catalyst cracking plant. Oil is vaporised in a furnace and enters the catalytic section of the plant. Regenerated catalyst flowing down a standpipe is introduced into the oil vapour stream and is blown up into the reaction vessel, in which a relatively high catalyst density is maintained owing to the settling action of the catalyst against the vapour flow. Catalyst and cracked product pass to a series of three cyclone separators where essentially all of the catalyst is removed. Cracked products containing a small amount of catalyst flow to the product fractionating system. The catalyst separated in the cyclone separators is collected in a spent catalyst hopper and from there flows down a standpipe to meet the regeneration air stream, which carries it into the regenerator. Owing to the slipping action of the catalyst, a high relative density of catalyst is mantained in the regenerator. The mixture of the flue gas and catalyst from the regeneration vessel passes first to a series of three cyclone separators and then to an electrical precipitator for catalyst recovery.

The flue gas leaving this dust collecting system contains only a minute amount of catalyst. The catalyst from the dust separation equipment is collected in a hopper, from which the regenerated catalyst flows down two standpipes. The catalyst flowing down one of these standpipes meets

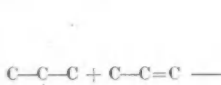
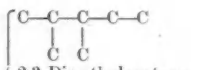
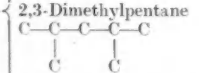
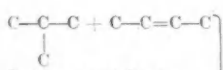
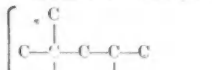
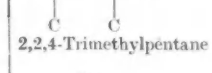
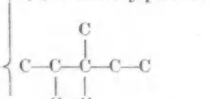
fresh oil vapour and thus completes its cycle. The catalyst flowing down the other standpipe meets a small quantity of regeneration air and is blown up through tube-and-shell coolers which assist in removing the heat evolved in burning off the catalyst. This quantity of heat in the design of the plant shown is normally much greater than can be put into the oil through the hot regenerated catalyst. The heat removed in the tube-and-shell coolers may be used for preheating oil, generating steam, and other purposes.

The cracked products which leave the catalytic system pass to suitable fractionating equipment. Normally this fractionating equipment will isolate the C_4, C_5, aviation petrol boiling above C_5, heavy naphtha, domestic heating oil, and heavy cycle gas oil fractions. The isobutane and C_4 olefines go into alkylate for aviation petrol, or some of the C_4 olefines may be used in the production of raw materials for synthetic rubber. The C_3 fraction may either go directly into aviation petrol or be subjected to further processing before such use. The catalyst carried over by the cracked products is collected at the bottom of the primary fractionation tower, and may be pumped back to the catalyst system as a slurry in cycle gas oil or be returned to the catalytic system by other means.

Three large fluid catalyst cracking units are now in successful commercial operation, and a large number are being erected.

The fluid catalyst principle has an important application to controlling the temperature of vapour or gaseous reactions, whether a catalyst is required or not. Where no catalyst is desired, an inert powder may be used to replace it. In vessels such as the reactor or regenerator in a cracking unit, the relatively high-density catalyst is in an extremely turbulent state. Because of this turbulence, the temperatures throughout the vessel are essentially identical. For example, in the regenerator of a typical large commercial unit: the heat liberated will be 120,000,000 B.Th.U. per hour. With this high degree of heat liberation, the maximum difference found at different points of the vessel has been less than 5° F.; this probably reflects inaccuracies of measurement rather than any real difference in temperature. The catalyst or inert powder gives the mixture in the vessel heat capacity and thus guards against rapid temperature fluctuations. Heat can be removed or added to the system by circulation of catalyst through heat exchangers, as used on the regenerator in Figure 2. The fluid catalyst principle can be applied here whether or not the catalyst needs revivification and even if no catalytic effect is desired. One application would be for controlling the reaction temperature in the oxidation of aro-

TABLE II. ALKYLATION REACTIONS

Raw Material	Main Products	A. S. T. M. Octane No. of Aviation Alkylate
 Isobutane Propylene	 2,3-Dimethylpentane  2,4-Dimethylpentane	87–89
Isobutane 2-Butene  Isobutane Isobutylene	 2,2,4-Trimethylpentane  2,3,3-Trimethylpentane  2,3,4-Trimethylpentane	93–95

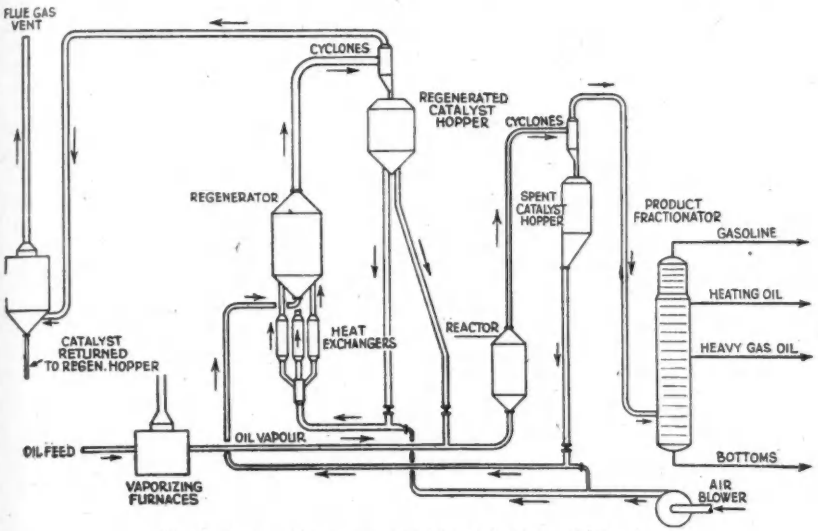


Fig. 2. Flow-diagram of fluid catalyst cracking plant.

matic compounds, particularly for the production of phthalic anhydride from naphthalene. It is believed that the fluid catalyst principle may be applicable in metallurgical processes for reducing ores and other operations, and to all types of reactions involving temperature control of gases, vapours, or solids.

An indication of the source of high-octane aviation petrol is given in Table 1, which indicates means for processing virgin naphtha and gas oil for aviation petrol. In general, virgin naphthas from certain types of crudes are of sufficiently high octane number to be used directly in aviation petrol. Virgin naphtha of lower octane number can be isomerised or further processed to give naphthas of sufficiently high octane number to go into aviation petrol. Hydroforming may be applied to a virgin naphtha fraction having a boiling range of, say, 200° to 300°F. for preparation of an aromatic blending agent to be used in aviation petrol. To convert gas oil into aviation petrol and raw materials for making it, such as isobutane and butylenes, catalytic cracking has most general applications. Fig. 3 illustrates the application of one type of catalytic cracking to aviation petrol production. From 100 barrels of gas oil charged, plus 9.7 barrels of isobutane, 56.9 barrels of aviation petrol are produced. This petrol is considerably higher in octane number than existing specifications require; it is possible to blend in 21.5 barrels of virgin naphtha, which is not sufficiently high in octane number for direct use, to give a total of 78.4 barrels of aviation spirit meeting 100-octane specifications for 100 barrels of gas oil cracked. This operation involves alkylation of olefines and some further processing of a portion or all of the catalytic naphtha. In addition to the 78.4 barrels of aviation spirit, 6.6 barrels of heavy naphtha are produced for motor petrol and 35 barrels of cycle gas oil. The latter may be further processed or used as light fuel oil. Catalytic cracking is essential for the large quantities of high-octane petrol required for the war.

In addition to catalytic cracking, hydrogenation is being applied on a limited scale for production of aviation petrol from gas oils. In general, where new equipment is involved, hydrogenation is not so attractive as catalytic cracking. Hydrogenation is also being applied for converting certain olefinic polymers to high-octane saturated compounds suitable for use in aviation petrol.

Butadiene for synthetic rubber is being produced both from *n*-butane obtained from natural gas fields or refinery operations and from *n*-butylenes obtained from cracking, particularly catalytic cracking. In addition, a certain amount of butadiene is being obtained from severe thermal cracking. The latter is part of the so-called quick butadiene programme.

Butadiene from butane is really a two-stage operation involving, first, the production of *n*-butylene from *n*-butane and then the conversion of *n*-butylene to butadiene.

Both steps are carried out in the presence of a catalyst. Production of butadiene from refinery butylenes involves, first, the segregation of *n*-butylenes and then the conversion of *n*-butylenes to butadiene through the use of a catalyst. The processes being applied for converting *n*-butane to butadiene were developed by Universal Oil Products Company, Phillips Petroleum Company, and Houdry Corporation. The process for conversion of refinery *n*-butylene to butadiene was developed by Standard Oil Development Company. Schematic flow sheets of the processes starting with *n*-butane and with refinery butylenes are shown in Fig. 4. Starting with field butane, the *n*-butane must first be isolated. It is then converted in two catalytic stages into butadiene; the conversion per pass, however, is incomplete. Lighter products are separated between both steps; they are hydrogen and cracked products. The C_4 fraction isolated after the second catalytic step is subjected to extraction to remove butadiene. Unconverted C_4 fraction is recycled. Where refinery butylenes are the starting material, *n*-butylenes must first be segregated, although in this step it is not essential to produce a fraction of high purity. This *n*-butylene fraction is then subjected to catalytic dehydrogenation; some cracking occurs and the conversion is not complete. The product is fractionated to give a C_4 fraction containing the butadiene. This fraction is then extracted to remove the butadiene, and the unconverted material is recycled. Equipment is being installed to produce butadiene from both raw materials on a relatively large scale. The major portion of butadiene from oil will, however, be made from refinery butylenes.

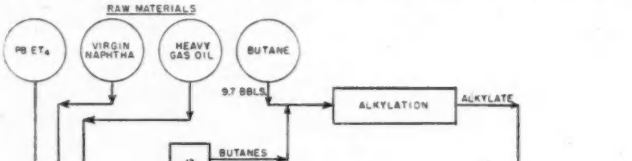


Fig. 3. Production of aviation spirit by fluid catalytic cracking.

The synthetic rubber programme involves production of butyl rubber on a relatively large scale. The main raw material for butyl rubber is isobutylene which can be extracted from refinery C_4 fraction. The

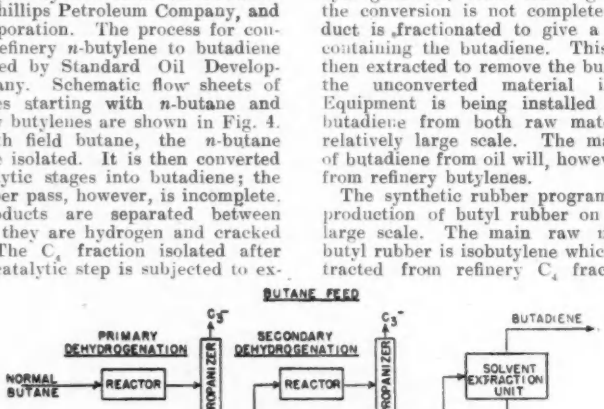


Fig. 4. The manufacture of butadiene.

bulk of isobutylene for butyl rubber will originate from catalytic cracking.

Much of our military equipment requires lubricating oils with detergent properties contributed by special addition agents. Oils containing these agents tend to keep carbon and lacquer deposits from forming on various parts of the engine. Movement of parts of aeroplanes, cannon, and other military equipment is controlled by transmission of pressure by a fluid generally called a "hydraulic oil." Since the equipment is subjected to widely varying temperatures, especially to very low temperatures, hydraulic oils must have a slow change of viscosity with temperature. Straight petroleum oils have too great a viscosity variation with temperature, but certain substances can be added to give the desired property. Military equipment must be shipped by water for long distances. Without suitable protection it will corrode and reach its destination in an unusable condition. The industry has met the need for rust-preventive coatings with petroleum oils containing special agents to give adhering films and to prevent rust. Many of these oils have the property of displacing water from metal surfaces.

Production of synthetic ethyl, isopropyl, and higher alcohols, as well as their derivatives, is continuing on an increasing scale. Naphthenic acids, phenols, and vanadium are being obtained from petroleum. Many new organic developments are based on petroleum. The future holds great promise in this field. Many of the processes discussed are the result of co-operative developments. The petroleum industry is working together as a team. In meeting war problems the industry has freely exchanged information on new processes and new products through the facilities provided by the Petroleum Administration for War. In this way the experience of any one unit in the industry has been shared by all.

REFERENCES

1 Houdry, Burt, Pew and Peters, *Proc. Am. Petroleum Inst.*, 1938, *19*, 133.

2 Simpson, Evan, Hornberg and Payne, *Ibid.*, 1942, III, *23*, 59-66.

The Importance of Manganese*

South Africa's Rising Output

SO marked is the similarity between the common minerals of both iron and manganese that up to the 18th century manganese was included among the ores of iron. The oxides are the most common minerals for both metals, while the carbonate and silicate of each occur. Manganese is a widely distributed metal, but constitutes only 0.09 per cent. of the earth's crust. Though small deposits are numerous, those rich enough to mine are far from plentiful, and production is restricted to comparatively few areas.

Manganese Ores

The commercial ores of manganese are mainly oxides, either deposited in sedimentary beds or concentrated by the action of surface waters in manganiferous rocks from which the impurities have been dissolved and carried away. The lower limit of most deposits is above the level of the ground water or within 150 feet of the surface.

Primary deposits of manganese are composed chiefly of carbonates and silicates, formed by solutions in the intermediate vein zone, where they are commonly associated with copper, zinc and silver minerals. Subsequent alteration of these deposits gives rise to zinc- or silver-bearing manganese ores. At the earth's surface the oxides are the stable forms of manganese; therefore, wherever a deposit of the carbonate or silicate is exposed at the surface, it is soon converted into a residual deposit of the oxides.

Commercial Grades

Manganese ores, which are extremely variable in composition, are classified commercially as follows:—

	Percentage of Manganese
Chemical ores	82 to 87
Manganese ore	35 (plus)
Ferruginous manganese ore	10 to 35
Manganiferous iron ore	5 to 10

For metallurgical purposes the one standard is 46 per cent. manganese, with not more than 6 per cent. iron, 8 per cent. silicon, 0.15 per cent. phosphorus, and 0.5 per cent. sulphur.

Before the first world war the largest producers of manganese were Russia and India, which accounted respectively for 50 per cent. and 40 per cent. of the world's total output. Russia's two largest deposits are those of the Georgian Republic and the Ukraine, each situated only a short distance from the Black Sea. The discovery of a very large deposit in Siberia has also been reported. In 1939, Russian production was on a scale sufficient to meet the entire European demand. India has large reserves of excellent manganese ores, located in the central provinces. An important deposit of ore, consisting mainly of psilomelane, occurs in the Dagwin mine of the Gold Coast, which has

* Condensed from *The South African Mining and Engineering Journal*, May 22, 1943.

ore reserves estimated to exceed 10 million tons. Japanese production was greatly stimulated by increased activity of the iron and steel industries during the first world war. Although manganese is widely distributed throughout Japan, the workings are small and conducted in rather a primitive fashion. It was reported recently that a deposit of manganese ore estimated to contain 10 million tons of ore had been discovered in Manchukuo.

In 1939, 191,319 tons were exported from Brazil; Cuban production is in the vicinity of 140,000 tons a year; and the Egyptian output for the same year totalled 85,785 tons. Among other producing countries are the Philippines and Spain.

TABLE 1
Production of Manganese Ore
(Metric Tons)

Year	South Africa	World
1930	147,321	3,513,000
1931	101,899	2,314,460
1932	—	1,289,300
1933	21,228	1,826,000
1934	65,590	2,964,700
1935	95,450	4,100,000
1936	258,245	5,310,000
1937	631,198	6,120,000
1938	551,742	5,198,000
1939	419,697	4,600,000

South African Deposits

Following the development of the extensive manganese deposits of the Postmasburg region, the Union has become an important exporter of manganese ore. Production began in 1929. Eight years later a record output of 557,210 short tons raised South Africa to the position of third among the world's producers, with an output exceeded only by Russia and India. The Postmasburg deposits are situated about 130 miles by rail north-west of Kimberley. Detailed investigation and development have disclosed large reserves of ore which are more or less confined to two belts of country, known as the western and eastern belts. In the western belt ore has been proved to be present along practically the whole length of the Gamagara ridge, a distance of about 38 miles. The eastern belt consists of a line of more or less detached hills and ridges rising from a level dolomite plain. In these hills manganese ore is located at or near the irregular contact between the dolomite and the overlying siliceous and Blinklip breccias. The discovery of a third and more westerly belt has recently been made. The ore minerals consist mostly of manganite and braunite. The phosphorus content is usually less than 0.15 per cent., the chief impurities being silica and iron. The bulk of the ore is medium to low grade, with 40 to 48 per cent. manganese, but first-grade ores containing over 50 per cent. of manganese, with an iron content ranging from 5 to 8 per cent., are also mined.

As a result of the war, the distribution of the South African manganese ore output has undergone a radical change. For several years before the war two-thirds of the total exports were shipped to Germany. Other pre-war markets included France, Sweden, the Netherlands and Spain, all of which were disrupted by the German invasion of the Low Countries and the fall of France, leaving the United States as the sole buyer.

Manganese is one of the eight essential metals of which the United States does not have sufficient supplies to meet its needs. Nearly 2000 manganese deposits scattered over 32 different States have been discovered, but the majority are of little commercial value. Important deposits are worked at Philipsburg and Butte in Montana, while other States producing high-grade ore include Georgia, Arkansas, Virginia and Tennessee. Ore containing 10 to 35 per cent. manganese is mined in Minnesota, Montana, Georgia, and Colorado.

The American Programme

Last year a programme for the development within the United States of a supply of manganese sufficient to free that country's steel and alloy production of any reliance on foreign sources was announced by the Bureau of Mines. This programme, designed to provide enough manganese to produce 87 million tons of steel annually, covered the utilisation of low-grade domestic manganese. The specific programme provides for the establishment of eight mills, three hydrometallurgical plants, including one electrolytic unit, and one matte smelting plant. It was anticipated that all these plants could be in operation at the end of a year and many at the end of nine months. A minimum of 526,000 tons of metal annually is provided for in the programme with a maximum of approximately 560,000 tons. This includes 12,000 tons of electrolytic manganese, which is of special value in low carbon steels, for shells, and in certain types of stainless steels. Approximately 11,500,000 tons of domestic ores can be processed annually. At present the United States consumes about half a million tons of manganese a year.

Beneficiation Tests

Since the tonnage of high-grade manganese ore in the United States is relatively small, it is apparent that large-scale production of manganese is possible only through beneficiation or low-grade material. With this in mind, a $2,000,000 Government appropriation was made available in 1940 to the Bureau of Mines for the construction and operation of pilot plants to beneficiate low-grade manganese ores for the production of metallic manganese from such ores, and for the development of manganiferous deposits. Microscopic studies of the physical characteristics of some low-grade ores indicate that many of these ores will require fine-

grinding to 65-mesh or smaller to liberate the included gangue particles. Experiments on the matte smelting or manganiferous ores are also under way. Preliminary results indicate that a matte containing 50 to 55 per cent. Mn., 5 to 8 per cent. iron and 33 to 35 per cent. sulphur (suitable for the manufacture of ferromanganese) can be produced. Tests have shown that low-grade ores from various States could be beneficiated to meet specifications for ferromanganese.

Strategic Importance

While not necessarily the most important strategic mineral, manganese certainly ranks among the most important, since it is an absolute necessity to the steel industry. Approximately, 92 per cent. of the total world production is used in the manufacture of steel. Manganese is added to steel: firstly, to act as a deoxidiser; secondly, to compensate for the bad effects of sulphur during fabricating processes in the manufacturer's plant; and third, to impart certain beneficial qualities to the product. The amount of manganese required for deoxidation is small. Roughly one-third of the manganese used is necessary to neutralise the bad effects of sulphur, the balance being employed to improve the steel. Of the many efforts to find a substitute for manganese as a deoxidiser for steel, none have so far proved entirely successful.

The manganese content of manganese steels ranges from 12 to 18 per cent., this variation being due to differences imparted to the steel by minute changes in the proportion used. Manganese steels are hard without being brittle and, though difficult to machine, malleable. The characteristics imparted to steels by the introduction of manganese give qualities adaptable to use where a high degree of resistance to abrasion and shock is required.

During the period, 1911-1923, world steel production was 881,675,000 long tons, while the output of manganese ore was 21,142,000 tons. These figures indicate a consumption of 53.7 lb. of manganese ore per ton of steel made. It may be added that after utilisation nearly all the manganese is dissipated in a form not susceptible to subsequent recovery as a secondary metal. Moreover, the amount of manganese produced in the form of pure metal is comparatively negligible. Manganese for steel production is generally converted from the ore into the ferroalloys, ferromanganese or spiegeleisen, with respective manganese contents of about 80 and about 20 per cent.

Electrolytic Manganese

Methods of preparing pure manganese metal for investigation work have passed through a cycle. Most of the research done before the turn of the century used Moissan's pyrophoric manganese, made by electrolysis with a mercury cathode and distillation in vacuo. Thereafter, investigators turned to manganese made by carbon and aluminium reduction because these methods were commercially feasible.

In 1934, the metallurgical division of the United States Bureau of Mines succeeded in obtaining a continuous deposition of high-purity manganese from aqueous solution. An electrolyte of manganese and ammonium sulphates was used, a suspension of manganese carbonate being maintained in the anolyte as a means of controlling acidity. This process has been revised and is covered by patents in the United States and other countries. Commercial production has been undertaken by several companies. An important practical problem that must be solved if the process is to be a success commercially is elimination of the sulphur found in the manganese produced by the bureau's process. This may be accomplished by fire refining. Boric acid is an effective sulphur remover, and can be eliminated from the product. The bureau's process produced about 20 per cent. of the manganese as manganese dioxide. Where there is a chemical market, disposal of this presents no problem, but with a large manganese plant is would be desirable to reduce or eliminate its production.

In summary, the problems involved in establishing the production of electrolytic manganese on a commercial scale have been solved, at least to the extent of permitting some commercial production.

Hydrometallurgical methods are also being tried for the extraction of the manganese content of low-grade ores, by leaching with various reagents. The manganese in the leach solution may be chemically precipitated to form a very high-grade concentrate or may be recovered directly as high-purity metal by electrodeposition.

Flotation Progress

Nowhere has flotation made more striking progress than in its application to manganese ores. The United States Bureau of Mines has demonstrated the feasibility of floating silica from low-grade manganese oxide ores, with the result that a pilot plant capable of concentrating 40 tons per day is being erected at Boulder City.

In the Anaconda copper mill one of the crushing and grinding sections and the old slime flotation division have been remodelled to treat 1000 tons of rhodochrosite ore per day. The ore is reduced in crushers and rolls, ground in ball mills, thickened and floated in 66 cells of Fagergreen flotation machines. The manganese concentrate is dewatered and then nodulised in a 270-ft. kiln. According to "Mineral Industry," soap reagents are believed to be used for manganese flotation. Any sulphides present in the ore may be removed by a preliminary step of flotation using ordinary frother and collector reagents.

LETTER TO THE EDITOR

Dr. Cullen's Challenge

SIR,—" Dr. Cullen's Challenge " in your issue of July 24, will, I am sure, meet with the warmest approval. I am, myself, particularly interested in Dr. Cullen's concluding paragraph concerning domestic nonferrous mineral deposits, as the view expressed by him definitely gives added force to my contention that drastic reform in applied technique is imperative if these minerals are to be utilised, as they should be, to best possible advantage. I have already dealt at some length with this subject in my articles published in your issue of February 13, March 20, and May 22 last; and if the mine owners will pay due heed, then the seeds I am endeavouring to sow may bear good fruit and help them forward in the direction of their own and the country's good. To neglect this advice can only lead to one ending, and that ending is certain, namely, to assist the foreign exporters whose products are at present superior to acquire once again a more or less complete control of markets, to the detriment of domestic producers. Moreover, the prospect of initiating a profitable and urgently needed export trade will vanish.

In the case of barytes, the custom in the past appears to have been widely one of grading by eye, thus producing, with or without chemical treatment, a series of more or less off-colour grades of fine ground powder for paint and other industrial uses. In other instances, the whole output of a mine, including the often extensive old dumps, is taken by the chemical industry, whereas the raw material should be graded in relation to the subsequent purification standpoint, seeing that those lodes containing ore which can be cheaply converted into a high quality prime white powder should unquestionably be retained for that purpose; and the chemical and other industrial users, including those requiring off-colour fine ground barytes, should be supplied with ore from other lodes containing barytes less qualified to provide a first-class white ground product. The need for a much improved technique will be better understood when it is realised that the ore most suitable for economical treatment need not be white but may be, and often is, badly discoloured. My immediate difficulty is, however, to overcome the initial inertia which at present tends to stifle progressive measures, but once that is accomplished then all is plain sailing.

Out of a list of 60 barytes mines situated in Westmorland, Cumberland, Durham, and Yorkshire, some are in work and others are idle. Many have been run by the small owners; some owners would develop and then find themselves without the means to provide a treatment plant. The next owner, taking advantage of the previous owner's inability, may have installed plant but, unable to maintain the necessary development work, in turn failed to keep the mine alive. In some cases the low prices then ruling for off-colour ground barytes, tended to aggravate the trouble. Times are now changed and rule-of-thumb practices must give way to the application of more advanced technique. This will not be found easy of achievement, there being so many little understood pitfalls to be avoided, and only those who have made a long and exhaustive study of the subject in its many branches can ever hope to achieve success at an economic cost per ton. The actual plant requirements present not the smallest difficulty and it has been found necessary to create new designs in order to obtain the desired results.

The first essential is to examine and classify the raw material at its source. Then, as it is naturally more economic to process on a large scale and where the necessary conveniences are available, which is not so at the mine, the plant employed should be entirely automatic and continuous in action, and of minimum labour requirement. It may be found more profitable to erect one plant centrally situated to take the output from a number of mines, for instance, at or near Appleby; and another works at a port convenient for shipments overseas, say, at Whitehaven. The ore would, of course, need to be dressed prior to despatch from the mine, in order to avoid paying carriage on waste material. Present plants existing for the manufacture of off-colour products might well continue on these lines.—Yours faithfully,

WALTER H. REYNOLDS.

July 31, 1943.

FERTILISERS IN SCOTLAND

Agreement to adopt fertilisers of standard composition was reached at a conference held in the West of Scotland Agricultural College attended by farmers, fertiliser merchants, and members of the college staff. The chairman, Principal Paterson, stressed the convenience of such standards which would enable agricultural executive officers to specify so many cwt. of, say, three particular compounds with the assurance of knowing these would be readily available in all districts. This course would also safeguard farmers against ill-balanced fertilisers. After a discussion, a vote was taken and the following limits for standard compound fertilisers adopted :—

	Nitrogen. %	Phosphates. Sol.	Insol.	Potash. %
Potatoes ...	6-7	8	1-2	9-10
Turnips	4-5	7-8	4-6	—
Grain	6	10-12	1-2	—

Parliamentary Topics

New Plant for British Celanese

IN the House of Commons last week Mr. Burke asked the Minister of Supply what was the product to be manufactured by the new subsidiary company of British Celanese known as Celanese Plastics Development, Ltd., for which he had authorised the release of materials for plant; and whether the production was to meet Government orders.

Sir A. Duncan: It would not be in the public interest to disclose the name of the product concerned, but I am able to assure the hon. member that its use will be controlled by the Government for approved purposes.

Mr. Burke: Is the minister aware that one of the largest manufacturers of this substance have had their plant idle for the last 18 months, and in encouraging and giving privileges to these large firms is he not making it impossible for the small firms to keep their heads above water?

Sir A. Duncan: These matters cannot be determined by demands at a given moment, but reasonable forecasts must be made as to the future course of things.

Mr. Burke: But why not use the plant already in existence in the country? Where are British Celanese going to get their labour?

Sir A. Duncan: All these matters were the subject of consideration when the plan was determined upon. It is true that there has been plant available for the present demand but on all estimates that can reasonably be made that plant will be fully required.

Oil from Coal

Mr. Sexton asked the Minister of Fuel and Power what progress was being made in British production of oil from coal and in the research work on the subject. The Minister of Fuel and Power (Major Lloyd George) said that during the war the use of home-produced liquid fuel had been developed on a considerable scale, by the substitution of creosote-pitch mixture for imported fuel oil. Research work on oil-from-coal processes was being continued at the Fuel Research Station and the subject was being studied in this ministry in connection with post-war developments. Mr. Mathers asked whether the Minister would keep in mind also the importance of the production of oil from shale. Major Lloyd George replied that he would.

British Carbide Production

Mr. Sexton asked the Minister of Supply what progress was being made in the manufacture in Britain of calcium carbide; and what percentage of the nation's requirements was now being manufactured in this country. The Minister of Supply said there were two factories in this country for the production of calcium carbide, one of which was being extended. It would not be in the public interest to give particulars of home output or of imports. In reply to a further inquiry as to whether the question of expanding home manufacture of calcium carbide was being considered by the Government as part of a post-war employment programme, the minister said that expansion was entirely for war purposes.

I.C.I. and Tetracene

In the House of Lords, Lord Strabolgi referred to statements that the Remington Arms Company, an American company and a subsidiary of another firm, had been charged by the United States Department of Justice with refusing to sell tetracene to the British Purchasing Commission, and that the Remington company had warned the A. C. Spark Plug Company that, because of an agreement with I.C.I., it could not use tetracene in ammunition sold to the British Government. He hoped there was no truth in the suggestion that I.C.I. or its agents tried to prevent the exploitation of tetracene, because of any cartel agreement or in an endeavour to maintain their monopoly and he was not suggesting that the chairman and board of I.C.I. acted willingly in any way contrary to British interest. "But I do suggest," he added, "that an explanation is needed and some light thrown on how the cartel agreement operated in this case during the period when we were at war with Germany and the United States was still non-belligerent."

Lord McGowan said it was not true that Remington's had been charged by the United States Department of Justice with refusing to sell tetracene-primed ammunition to the British Purchasing Commission. Certain statements made before a committee of the United States Senate were later withdrawn after an explanation of the facts from the Remington Company. There were no agreements with I.C.I. which would have prevented Remington's from supplying tetracene to Britain, and this applied equally to the A.C. Company. Had there been any such agreements the I.C.I. would have at once waived their rights, and the British Government had adequate means to compel them to conform with national policy. So far as he was aware, Britain never called for the use of tetracene.

Lord Portal, for the Government, said there was no evidence of any refusal to supply tetracene to Britain.

Personal Notes

MR. C. PAIN has been appointed research manager of I.C.I. Dyestuffs, Ltd., in succession to MR. M. BARROWCLIFF, who has retired.

DR. W. G. OGG, who is leaving the Macaulay Institute of Soil Research to become director of Rothamsted, was given a farewell luncheon yesterday by the Aberdeen Chamber of Commerce.

LIEUT.-COLONEL W. E. PHILLIPS, who has been appointed a director of the Royal Bank of Canada, is also head of Research Enterprises, Ltd., a Government company making lenses and optical instruments. He has for some years been an outstanding figure in the Canadian glass industry.

Obituary

DR. CHARLES J. S. THOMPSON, who has died at Thame, Oxon, at the age of 81, had devoted his life to the study of the history of chemistry and of pharmacy, and was especially noted as an authority on toxicology. A native of Liverpool, he came to London in 1900 to take up the post of curator of the Wellcome Historical Medical Museum. Retiring in 1926, in the following year he was appointed honorary curator of the historical section of the Museum of the Royal College of Surgeons, where he worked continuously until the collection was almost entirely destroyed by enemy action in 1941.

SQUADRON-LEADER JOHN CHAMPION CARVER, D.F.C., R.A.F.V.R., who was reported missing in June, 1942, is now presumed killed in action. Shortly after leaving Oxford, where he took up flying with the University Air Squadron, his work with I.C.I. took him to Singapore, where he joined up for active service on the outbreak of war. He was soon after posted to England and in 1942 was appointed to No. 118 Squadron as its leader. He was awarded the D.F.C. for his courage and resourcefulness when shot down, in March, 1942, near the Channel Islands. After 57 hours in his rubber dinghy, he navigated to within 12 miles of the British coast, where he was picked up by a destroyer.

Production-Planning Courses

New Ministry of Labour Scheme

THE Ministry of Labour and National Service, in conjunction with the Board of Education and the Scottish Education Department, is organising courses of lectures on Production Planning at various technical colleges throughout the country. The lectures will cover workshop organisation and lay-out of plant, operation lay-out, materials, control of quality, motion and time study, and workshop economy. The courses, which are intended for men and women engaged on planning work or with experience of it, will normally be of 20 hours' duration and will be given in evening meetings of two hours each. No fees will be charged, but the Ministry will not pay any allowances or expenses. Employers are particularly invited to put forward suitably qualified persons from among their employees. Names and addresses of persons wishing to attend the course should be sent to the local employment exchange with full details of technical experience and present employment. When the number of applications justifies the establishment of a course applicants will be notified.

A New Type of Insulin

In Combination with Blood Protein

A NUMBER of experimental and clinical reports have been published during the past few years on the development of an interesting new type of insulin. Globin Insulin, as the new preparation is called, appears to possess numerous advantages over the existing types of insulin. In rapidity of onset and duration of action it may be regarded as midway between unmodified (soluble) insulin and protamine zinc insulin (suspension). It thus affords smoother control of the blood-sugar level than is possible with the former, while avoiding the risk of nocturnal hypoglycæmia and overlap of effect which are commonly encountered with the latter. In many of the cases observed a single daily injection has been found adequate for satisfactory control. Globin insulin, as its name implies, is a combination of insulin with globin, a simple protein obtained from red blood cells by removal of the chromogen fraction. It forms a clear aqueous solution at a *p*H of 3.7, and, as issued, each c.c. contains 80 units of insulin, 3.04 mgm. of globin, and 0.24 mgm. of zinc (as chloride).

The available clinical evidence suggests that this new preparation may occupy an important place in the treatment of diabetes. It may be expected, for instance, to supersede to a large extent the simultaneous administration of unmodified insulin and protamine zinc insulin. Several workers have drawn attention to the fact that globin insulin does not produce local allergic reactions, such as are occasionally noted with protamine zinc insulin, while comparative studies which have been made suggest that patients receiving globin insulin can be maintained on a smaller daily unit dose than is necessary with unmodified insulin or protamine zinc insulin. Globin insulin (with zinc) was originated and developed by L. Reiner, D. S. Searle, and E. H. Lang, in the research laboratories of Burroughs Wellcome and Co. (U.S.A.), Inc., at Tuckahoe, N.Y.

Metallurgical Section

Published the first Saturday in the month

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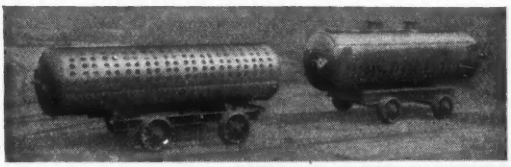

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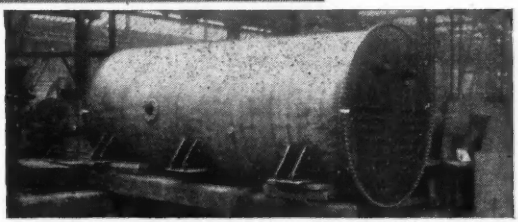

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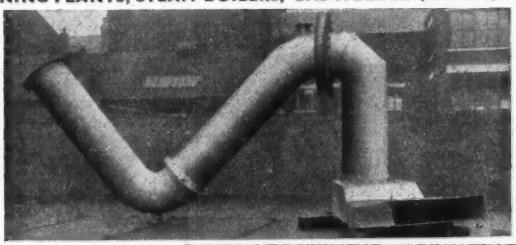

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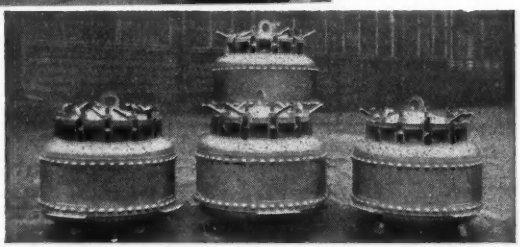

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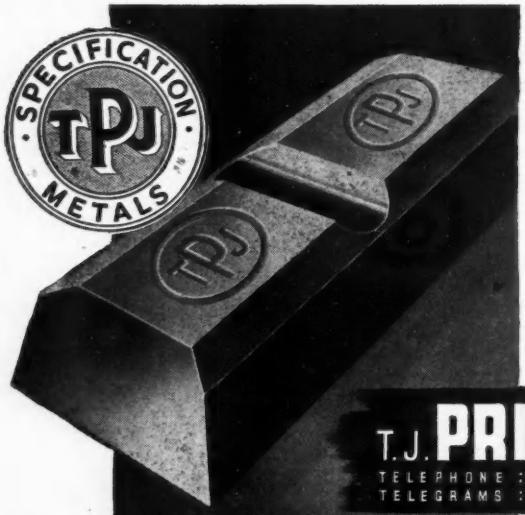

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Metallurgical Section

August 7, 1943

The Casting of Brass

Treatment of Billets and Strip Ingots

A BRIEF survey of most of the fundamental principles involved in the production of billets and ingots of copper-zinc alloys is contained in Bulletin No. 2 of the General Metal Utilisation Co., Ltd., 55 Bishopsgate, E.C.2. The notes have been divided into five sections, covering (1) 60/40 brass billets; (2) 70/30 brass ingots; (3) gilding metal and cap-copper ingots; (4) moulds; and (5) mould dressings.

60/40 Brass Billets

This type of alloy is usually manufactured to B.S.S. 249 which, giving the manufacturer a certain tolerance on composition limits, permits a diversity of scrap metals and alloys to be used in its production. The cast structure, on microscopic examination, is seen to be duplex, the alpha and beta phases being present in the field in roughly equal proportions. The lead is visible as free globules scattered throughout the mass, tending to segregate at grain boundaries, particularly in a slowly-cooled casting. Subsequent working and annealing cycles break up the original crystal structure and a more uniform distribution of the lead particles tends to result. These lead particles, set, as they are, in matrices of different hardness, are responsible for the excellent machining qualities possessed by this brass.

It is advisable to remove oil cutting lubricant from scrap metals prior to their inclusion in the melt. This can be done centrifugally in a very short space of time. From the point of view of economy in handling and melting, scrap should be baled or briquetted, this being best incorporated with a magnetting operation, magnetting continuously over a rotary machine, which in turn feeds the briquetting equipment.

Lead should be added to the charge as a secondary alloy, a copper-lead alloy of 60/40 per cent. being recommended. This assists in thoroughly mixing the lead in the charge. The charge should be stirred well before pouring in order to ensure efficient mixing, and skimmed immediately prior to pouring; melt it as rapidly as possible, and pour the charge immediately it is skimmed and ready.

Pouring temperatures between 1040° and 1080°C. are desirable, and any error should tend towards the high rather than the low side. Cold pouring results in a number of defects, such as cold shuts (folds on the billet surface caused by partially melted globules of metal splashed into the mould), porosity of the billet, and porosity of the surface regions of the billet; also the defect known as "blowing." The pouring speed should be carefully regulated and maintained; the determination of the actual amount of such flow is a rather difficult matter and the safest rule is to pour the billet as quickly as is compatible with a sound interior. The faster the pouring speed, the smoother the surface up to a point, this benefit being limited by the fact that beyond a certain speed the danger of the formation of shrinkage cavities becomes increasingly acute. Much scrap can be eliminated by close and careful supervision of the final stage of pouring.

It should be ensured that the mould contains a sufficient body of metal within itself to ensure a chill casting. Slow cooling is detrimental to the physical properties of the billet, producing a coarse micro-structure and resulting in segregation of the lead with the formation of lines of weakness. In the case of billets of large diameter, the line of weakness would tend to run down the centre. Here, lead concentration may be so acute as to impair the quality of rods extruded from such a billet. In the case of square billets or slabs for rolling, actual splitting may occur, either during the first rolling, or during the first annealing, should the actual reduction be under 30 per cent.

70/30 Brass Ingots

Ingots of 70/30 brass for rolling into strip must be made from the purest and cleanest scrap metals available, with the incorporation of virgin copper and spelter. The micro-structure of a cast 70/30 brass that complies with B.S.S. 267 would be revealed as consisting of a single phase, the alpha constituent. This phase is a solid solution, and faint dendritic characteristics can be observed, these being eliminated by subsequent annealing, or rolling and annealing. It is advisable to utilise at least 30 per cent. of virgin metal in each melt; the copper being first introduced into the crucible or furnace, then the scrap, and finally the spelter, the latter shortly before pouring.

The following points should be noted:

(a) Melt as quickly as possible, keeping the charge covered with a layer of stick charcoal or flux.

(b) Mix well before the pouring operation.

(c) Skim the charge carefully before pouring, removing all dross, charcoal, or flux from the surface of the molten charge.

(d) The correct pouring temperature is between 1100° and 1150°C. Pouring from too low a temperature will tend to produce defects similar to those already mentioned; while an excessively high temperature may lead to the trapping of globules of volatilising zinc, as well as a tendency, in the case of crucible casting, for the melt to absorb furnace gases. Such gases may be precipitated, on solidification, as pin-holes in the ingot.

(e) Maintain carefully the correct pouring speed. Modern practice is to pour into vertical moulds through runner-boxes, and, if the molten metal is flushed quickly into the runner-box, and a feeder head of 3 in. to 4 in. is maintained during the whole of the pouring operation, the correct speed is easily kept up throughout the casting process. The speed of pouring should be as fast as is compatible with a sound interior in order to ensure as smooth a surface as is possible. The recommended speed of rise within the mould when casting an ingot 12 in. wide by 1¼ in. thick is between 1½ in. and 2 in. per second.

(f) Carry out final feeding with care, thus preventing piping and subsequent lamination of the rolled strip. Incidentally, it is desirable to allow some of the metal to overflow at the end of the pour so as to carry off any skim which may pass through the holes in the tundish.

(g) Ensure that the moulds, by virtue of their design, are capable of chilling the casting as much as possible. This helps in the production of a fine micro-structure, which is important, particularly when the ingot is to be rolled to a fairly thick finished gauge. A coarse grain is detrimental to the working properties of the finished strip, and will persist during the initial cupping and pressing of the cartridge, resulting in a rough surface.

Gilding Metals

The production of 90/10 and 97/3 and similar alloys used to-day for the manufacture of bullet envelopes, percussion caps, and primers, deserves special mention. It is advisable to use only virgin metals or actual process scrap emanating from previous manufacture. The micro-structure of a cast gilding metal of the order of 90 per cent. or 97 per cent. copper would be that of a single phase, the small amount of zinc present being completely dissolved, and the dendritic effect being so slight as often to be scarcely noticeable. The grain size of such alloys, after the necessary rolling and annealing operations have reduced them to the finished gauge, is usually smaller than is found in the alpha brasses, being of the order of .035 mm. in the dead soft condition.

The Use of Phosphorus

The following points are of extreme importance:

(a) Melt as quickly as possible and keep charge covered with stiek charcoal.

(b) Deoxidation of the melt shortly before pouring is essential. Phosphorus, in the form of a pre-prepared alloy with copper, is usually employed, and the amount of ingoing phosphorus should be carefully calculated. Modern specifications emphasise the necessity of keeping the ultimate phosphorus content at .005 per cent. or less. Excess of this substance has an appreciable hardening effect on the alloy, and higher annealing temperatures are necessary when such excess is present. When using parcels of process scrap in the melt, calculation of the ingoing quantity of phosphor copper must make allowance for such phosphorus as the scrap may contain. Absorption of free or combined phosphorus after deoxidation is usually assayed at between .0025 per cent. and .004 per cent.

(c) Pouring temperature should be kept on the high side, 1200°C. being recommended. The charge loses heat fairly quickly, especially if several ingots are to be poured from the same melt, and a certain amount of super-heat at the beginning enables the correct mean temperature to be maintained.

(d) The pouring speed is extremely important, and is not always easy to regulate. Here, again, a high pouring speed is desirable, up to 2½ in. per second being recommended for an ingot of 12 in. by 1¼ in. cross section. Where upright moulds and runner-boxes are used it is found that appreciable wear takes place around the runner-box holes. Inter-hole fracture occurs, together with wearing away of the iron of which the box is made. The high temperatures involved are responsible for this, and the employment of runner-boxes constructed of a nickel-chrome cast-iron is recommended.

(e) Owing to the high melting point, the cast ingot remains in a liquid state for a slightly longer time after pouring than do the other previously mentioned copper-zinc alloys. Thus the danger of porosity due to entrapped air, and gases evolved from the dressing, is lessened; but the feeding of the ingot at the end of the cast must be carried out even more carefully and more time should be devoted to this important operation.

The design of moulds must of necessity conform to the requirements of each parti-

cular foundry. However, the ideal design should embody:

(a) Vertical pouring, to prevent the impingement of the molten stream upon the mould face during the pouring operation; (b) the use of runner-boxes or tundishes, regulating to a predetermined speed the flow of metal into the mould and providing a feeder head of molten metal, which serves to prevent the entry of undesirable dross; (c) quick removal of the cast ingot. In the case of strip moulds, the "book" type (hinged at the side) would seem to be the ideal design, while in billet production a gentle taper towards the bottom, with ample room for removal of the billet by gravity, has been proved to be the most practical form; (d) accessibility for the cleaning operation is also vital. Here, again, in the case of the strip mould, the "book" type offers the best solution, presenting both faces without obstruction.

Mould Materials

The choice of materials for mould construction is fairly limited, the most common being cast iron, mainly on account of its ability to be moulded and machined easily to a given pattern; because of the hardness that is procurable on the casting face; and because warping is reduced to a minimum. Cast iron, however, after a number of casts, has a tendency to develop surface cracks running across the mould face. These are caused by the constant recurrence of sharp heat gradients produced in the mould material at each pouring, the continued cycle of expansion and contraction culminating in fracture. These cracks develop eventually to such an extent that the moulds are rendered unfit for use. It is possible, however, to improve the life and performance of such moulds by the employment, in their manufacture, of only the best pure hæmatite iron; by the addition to the iron of a little steel; or, better still, by the use of cast iron containing a small percentage of nickel-chromium.

It is often a matter of debate whether the actual mould face is improved by machining or whether it is not. It is our studied opinion that it is definitely advantageous to machine the casting face, particularly when the moulds are constructed of alloy cast iron. Again, when moulds have been in service for any length of time it will be found that another light machining of the casting faces will give them a new lease of life, as well as improving the surface of the cast ingots.

The primary function of a mould dressing is to protect the mould face; and, in the case of brass production, to produce a flame sufficient in volume to exclude all air from the mould during the pouring operation, this with the object of preventing oxidation. The dressing should be of such a nature that it can be applied to a mould having a temperature of 100°C. or slightly more, without breaking down on drying off during the time which must elapse before pouring is commenced. Should a dressing have a tendency to leave dry patches owing to its having too great a degree of volatility and thereby allowing the molten metal to contact the actual mould face, gases are evolved from the iron itself, which ripple the surface of the cast ingot, causing "blowing."

Then again, the dressing should not leave a hard deposit, difficult to remove, and apt to "build up" and ruin the surface of the mould. Such deposits adversely affect the ingot surfaces and often have a tendency to absorb a certain amount of dressing, thereby causing delay in its combustion and subsequent "blowing" of the ingot surface. The dressing should burn quickly when in contact with the molten metal, otherwise gases from the burning dressing may be in process of evolution while the metal is solidifying. The result of this would be porosity in the ingot. The presence of moisture in the dressing is exceedingly harmful and should be reduced to an absolute minimum. Its total absence can be guaranteed only in a dressing manufactured with special dehydrating apparatus that is not usually available in the foundry.

The Choice of Dressings

The roots of many casting problems lie deep in the over-common practice of using, not the dressing that is chemically and metallurgically most suited to the production of a particular foundry, but some home-made concoction that gives results just good enough for its use to become a habit difficult to change. For instance, dressings compounded of resin are apt to provide a surface whose smoothness is a deception in that it hides, so frequently, various degrees of sub-surface porosity. General Metal Utilisation, in the light of experience gained in dealing with the problems of many rolling mill foundries, and because of the necessity for war-time economy, have found it necessary to produce, not only those dressings which are known to be most exactly suited to conditions where moulds are perfect and easily renewable, but also other dressings specially evolved to deal with war-time conditions. Therefore they have placed at the disposal of foundries two dressings for each purpose, the first one of special preparation and superfine quality for use with new and perfect moulds, and the second a dressing of heavy body that, apart from its usual properties, tends to fill up cracks and remedy other faults in moulds which are poor or deteriorated. Both types of dressing reduce to a minimum the formation of "discard head," as well as the necessity to machine strip and ingot surfaces prior to rolling.

The Longhorn Tin Smelter

Guaranteeing America's War-Time Requirements

THE construction of the Longhorn Tin Smelter on the Gulf Coast of Texas, an important part of the American programme for the production of high-grade refined tin from low-grade Bolivian concentrates, has been outlined in the American technical Press by C. B. Henderson, president of the Metals Reserve Co. Arrangements having been made for the purchase of Bolivian ores, proposals from several companies to construct and operate the smelter were considered, and it was finally decided to put this undertaking in the hands of the Billiton Company because of its success in operating its tin smelter in Holland. The siting of the plant was an important problem. Low fuel costs and cheap hydrochloric acid were essential, so it was early decided that a location on the Gulf Coast would be most suitable. A site in Texas was eventually selected. The actual building of the plant started in October, 1941, and in April last year the first tin came from the furnace.

In the meantime, two of the large tin-smelting centres of the world—Singapore and Penang—had fallen into enemy hands. As a result, immediate expansion of the Texas smelter was considered desirable. To-day, the plant is turning out 50,000 long tons a year, and has a capacity equal to the present rate of consumption of tin metal in the U.S.; its actual output, of course, is governed by the amount of ore on hand. Thus the U.S. is in a safe position with respect to tin although two-thirds of the world tin capacity is in Japanese hands.

Process Used

The Longhorn Smelter was constructed to handle all grades of tin compounds, from the pure alluvial concentrates to the lowest grades of primary ores. With pure alluvial ores, containing only small amounts of silica and iron and traces of other metallic impurities, a simple two-stage reduction process carried out in reverberatory furnaces yields a high-grade metal at a high recovery rate. The greater part of the primary ores and concentrates from Bolivia, however, contain base metals in such quantities that reverberatory smelting would yield a low-grade metal with a limited use. In addition to the base metals such as arsenic, antimony, copper, lead, and bismuth, these ores contain an excessive amount of sulphur, which must be eliminated before reverberatory smelting can be employed. The iron content also is often too high for direct smelting. The percentage of silica in low-grade Bolivian ores, too, is excessive.

On arrival at the smelter the ore is weighed, sampled, and stored in piles according to the treatment it requires. Most ores treated there have a silica content of less than 10 per cent. The ore is then calcined, with or without the addition of a reducing agent or common salt, and the iron and other impurities are rendered readily soluble in hot hydrochloric acid. The calcining is carried out in Unax kilns provided with water-cooled cylinders in which the hot calcined ore is cooled to room temperature with the exclusion of air to prevent re-oxidation.

Separate Treatment of Dust

The extreme fineness of the ore causes dust losses in the kilns; most of this dust is precipitated in Buell cyclones connected directly with the kilns. The cooled gas is further treated in a Cottrell installation where the remaining dust is precipitated together with the fumes; this precipitate runs high in antimony and arsenic and is, therefore, treated separately. The calcined material from the kilns is leached with hot hydrochloric acid in digesters of spherical design and with a rubber lining that is protected from heat and abrasion by two layers of acid-proof brick. Steam, necessary to ensure the desired leaching temperature, is supplied through one of the hollow trunnions. The spheres rotate slowly so that the ore is agitated continuously and a high elimination of impurities is obtained. Leaching time depends on the amount of impurities present and varies between four and eight hours. The capacity of the digesters varies with the specific gravity and the iron content of the ores treated, and ranges between eight and eleven tons per batch. Leaching is followed by filtering of the chloride solution in Nutsch filters. After washing with diluted acid, the residues are of such purity that subsequent treatment in the reverberatory furnaces will yield a metal of at least 99·80 per cent. tin, which complies with the S-14 specifications issued by the Procurement Division of the U.S. Treasury Department.

BRAZIL'S BAUXITE DEPOSITS

Progress is reported in the exploitation of the large deposits of bauxite and the development of an aluminium industry in Brazil. Plants are being constructed in Ouro Preto, Minas Gerais. One will consume about 10,000 to 12,000 tons of bauxite annually and produce between 5000 and 6000 tons of aluminium. The other will produce metallic aluminium; initial production will be 2000 tons a year, or about 20 per cent. more than Brazil's normal consumption. Power will be furnished by a hydroelectric plant with a capacity of 14,500 h.p.

The Metallurgy of Antimony*

Methods of Production and Commercial Uses

THE chief sources of antimony are stibnite, valentinite, senarmontite, cervantite, stibiconite, kermesite, and native antimony. Stibnite (Sb_2S_3), the most important of these ores, is usually found in confused aggregates of needle-shaped crystals. It is leaden-grey with a metallic sheen and fuses readily. Valentinite (Sb_2O_3) appears in fan- or star-shaped crystals. It has a lamellar structure, a distinct lustre, and is perfectly white and almost transparent. Senarmontite (Sb_2O_3) is octahedral in form, with a resinous lustre but little colour, and varying from translucent to transparent. Cervantite, a decomposed stibnite, has needle-shaped crystals, and varies in colour from brown-yellow to almost white. It is easily reduced on charcoal. Stibiconite is pale yellow or sometimes reddish-white, and is found in crusts or powder form. Kermesite ($2SbS_3.Sb_2O_3$), found in tufts of cherry-red hair-like crystals, is formed by the partial oxidation of stibnite, and can be transformed by further oxidation into valentinite or cervantite. Native antimony is tin-white and very brittle.

There are also many antimonides of silver and other metallic elements; as well as a series of intricate sulphides and oxides. Antimony is also found in alliance with arsenic, as in allemontite; with nickel, as in breithaupthite; with bismuth and lead in kobellite; and with tin and lead in franckeite. All these minerals, however, are of uncommon occurrence.

Liquidation

Owing to the softness and frangibility of stibnite, and its lightness in weight, it is not economical to use water concentration methods, as wastage through slime formation would result; unless, of course, the ore contains a high percentage of precious metals. Antimony sulphide can be concentrated by flotation, for which process the ore must be finely ground. Creosote oils with sulphuric acid produce the greatest recovery percentages at the least expense, and the total may be increased by retreatment of the primary flotation tailing. Production of metallic antimony is carried out in six ways. The first is liquation to crude antimony, which is used for ores with between 40 and 90 per cent. of sulphide. Intermittent liquation is generally carried out in fireclay crucibles placed vertically in rows in an open fire, each row having a brick wall to separate it from the next. The bottom of each crucible has four or five holes to allow the liquid sulphide to fall into a receptacle of burnt clay. Where continuous operation is desired, tube furnaces vertically located above receivers, or reverberatory furnaces having a tap hole in the deepest point of the bed for removal of the liquiated sulphide, have been employed. The liquation process is, however, wasteful because the residues have as much as 15 per cent. of antimony left in them.

Three-Stage Treatment

The production of antimony from rich stibnite or liquated sulphide must be considered next. Rich stibnite contains 60 per cent. of antimony. The ore is placed in crucibles made of a mixture of fireclay and plumbago on the bed of a long reverberatory furnace. The sulphide is first reduced by wrought iron scrap, the result of which is a metal termed "singles," made up of about 91.63 per cent. antimony, 7.23 per cent. iron, and 0.82 per cent. sulphur. To this is added some salt, which aids in slag formation and fusion of the gangue. The next charge comprises the metal produced by the first stage, plus common salt, and a quantity of liquated sulphide. The resulting metal, called "star bowls," is made up of 99.53 per cent. antimony, 0.18 per cent. iron, and 0.16 per cent. sulphur. Finally, the "star bowls" are mixed with antimony flux and liquated sulphide, and the result is "star" antimony, the ingots of which are commercially termed "French metal." The total loss due to volatilisation is in the region of 10 per cent. The fume given off is collected in condensing chambers. In reverberatory furnace practice, the two stages are fusion with scrap iron to produce crude metal, and refining fusion.

Poor ores are usually treated to-day by volatilising roasting. The most widely employed type of plant for this work is made up of a rectangular roasting furnace built of firebrick, having a step gate of bar iron. The top part of the furnace communicates with a number of chambers furnished with condensation pipes of corrugated iron or of iron with projecting fins, through which the air and dust are sucked by means of exhaust fans. Beyond the condensing chamber is a coke-tower. Water passing through this lays down the final traces of uncondensed oxide. When the furnace is at the proper temperature, the charge, comprising 50 kg. of ore (containing from 15 to 20 per cent. antimony) together with about 2 kg. of charcoal, is inserted. Roasting takes place at a maximum temperature of 400°C. and the result is a yield in oxide of at least 90 per cent. of the metal contained in it.

Antimony oxides are always reduced in

* Abstracted from an article by L. Sanderson in *Canadian Mining Journal.*

small reverberatory furnaces by carbon in the presence of alkaline fluxes; *e.g.*, crude sodium carbonate (soda ash), sodium sulphate (salt cake), and on occasion, common salt. The furnace flue must be linked up with a condensing system of compartments or pipes. The metal is generally refined in crucibles or a reverberatory furnace.

Direct processes for low grade ore comprise smelting in a blast furnace with a tall shaft to lessen volatilisation, and a suitable condenser. Stibnite, slag and liquation residues with 25 to 40 per cent. antimony can be dealt with by this process, and iron is not needed for the reduction. Electrolytic methods of antimony extraction are known but have not been commercially adopted.

Commercial Uses

Antimony has a wide range of commercial uses. In metallic form it can be precipitated from an acid solution of antimony salts by metallic zinc. It is then in powder form, known as "iron black" or "antimonial black" and is employed in giving a metallic appearance to pottery or objects of papier maché, to other metals, and to gypsum. Some of the sulphides are used for rubber colouring and vulcanisation, for making safety matches, and for making vermilion, orange-red, and orange-yellow paints. Another use is to line lead chambers for making sulphuric acid. Yellow and blue pigments are also made with antimony sulphides.

Antimony oxides are employed in the manufacture of enamels; as a colouring agent in glass and pottery; in the preparation of artificial gems; as a pigment for hard porcelain, stoneware or glazed earthenware; and as a water-resisting white paint. Blends of oxide and sulphide provide yellowish-red and dark-brown pigments. Antimony sulphide and dry carbonate of soda give a brown-yellow pigment.

Antimony salts are used as mordants, *e.g.*, tartar emetic, for dyeing, thickening, and decolorising. Liquated antimony sulphide is employed in the priming caps of explosive shells. It is sometimes used in the shells themselves to give off a thick white smoke as an aid to range-finding. Sugar of antimony is used in furniture polish, and "antimony butter" ($SbCl_3$) is a fireproofer for preservatives of wood, paper, and textile fabrics, *e.g.*, creosote, pitch, tar and asphalt. Antimonic acid is used in aniline manufacture.

The alloys of antimony are many, and include valuable metals such as the Britannia metal alloys, the bearing or anti-friction metals, the metals used for printers' type, the hard or antimonial leads, and a range of miscellaneous alloys of less importance, such as battery plate alloys, ships' nail alloys, metallic mirror and button alloys, jewellery alloys, and cable sheathing alloys. The principal metals with which it is alloyed are tin, lead, copper, zinc, and bismuth. Gold is sometimes alloyed with it for jewellery manufacture. Antimonial leads are used for shrapnel bullets, sheets for acid chambers, battery plates, and acid-resisting cocks and valves.

Fabricating Steel Slabs

A New Moulding Technique

A REMARKABLE study has been carried out at the Technical College, Aix-la-Chapelle, by the engineer P. F. Erichsen, involving a new melting procedure for the formation of steel slabs, whether square, rectangular or round. In the processes employed up to date, cavities have invariably occurred, with the result that a great proportion of the output of forged steel has proved useless to industry. In the course of a melt it has been customary for the ingot to be maintained in a vertical position during solidification and cavities have thus been formed in the upper part of the ingot. According to the account of the Erichsen process given in *Dyna* (1943, April, p. 196), the melt is carried out with the ingot in a horizontal position, thus avoiding also any secondary internal cavities. The ingot-mould must be constructed in such a way that cooling can start only from the surface of the ingot which rests on the base of the mould, cooling from the other surfaces being entirely eliminated. The base of the new type of mould is made of copper and is water-cooled. Tests have been made with light metals, which have given highly satisfactory results, and excellent results have also been given by experiments with steel, utilising the new process.

METALLURGICAL PROGRESS IN PERU

The lead-zinc concentrator, with a daily capacity of 800 short tons, at Cerro de Pasco, originally designed for the contemplated electrolytic zinc plant, will be used for copper ores. A pilot electrolytic zinc plant operating on an experimental basis is now producing zinc on a substantial scale. The construction of large coke ovens at Oroya is being completed by the Cerro de Pasco Copper Corporation. The sum of $4,000,000 has been allotted by the U.S. Government for the construction of a new leaching plant, with a daily capacity of 200 tons, for the treatment of vanadium ores at the Minasragra mines of the Vanadium Corporation of America. Construction of this plant is proceeding with machinery and supplies from the United States. Work in the mica fields of southern Peru has been started for the production of sheet mica, shipments of which are expected to go forward during the coming months.

General News——From Week to Week

Sir John Anderson, Lord President of the Council, is in Washington on a brief visit to discuss scientific research problems connected with the war.

Increased use of producer-gas from wood charcoal, as an aid to British forestry, was advocated by Lord Trent in the House of Lords last week.

Staffordshire Iron and Steel Institute, at its annual meeting last week, elected Mr. Bernard Thomas, managing director of Midland Heat Treatments, Ltd., as president to succeed Mr. A. Wright. Dr. J. F. Hurst was elected senior vice-president.

A new booklet entitled "Heat Treatment of the Wrought Aluminium Alloys—Part 2, Equipment," has been published by the Wrought Light Alloys Development Association. It is complementary to the recent bulletin dealing with the practice of heat-treating these alloys.

Prospects for closer association between farming and industries such as the chemical and machinery industries were described as good by a member of the Agricultural Development Board, Mr. Roland Dudley, speaking to an audience of farmers at Leeds last week

New members of the Manchester Chamber of Commerce include Hyprol (Manchester), Ltd., manufacturers of penetrating and protecting compounds, 40 Dickinson Street, Manchester, 1, and the London Oil Refining Co., petroleum blenders and liquid soap manufacturers, Croft Street, Manchester, 11.

Phosphate deficiency is more pronounced in old grassland than in rotation land, though even in the latter there is a widespread need for phosphate, states Dr. A. B. Stewart, of the Macaulay Institute, in an article on soil research in the Transactions of the Highland and Agricultural Society of Scotland. He adds that old grassland soils are generally richer in potash than rotation land.

The Trading with the Enemy (Specified Persons) (Amendment) (No. 10) Order, 1943 (S.R. and O. 1943, No. 969), which came into force on July 27, contains 261 additions to the "Black List" of traders abroad with whom it is unlawful to have dealings of any kind. Additions of chemical interest include: La Química Industrial E. M. Bertolo, Salta 713, Buenos Aires, and Yatay 2803, Valentin Alsina, Argentina; Cia. Colombiana de Cloro and Minera de Asbesto Colombiano, Medellín, Colombia; A.G. für Chemie und Hydro-Chemie, Löwenstrasse 17, Zurich, Switzerland. The Laboratorio Químico Bioterápico "Antipiol," Ltda., Rua Tamandare, S. Paulo, Brazil, is removed from the list.

The Minister of Production, Mr. Oliver Lyttelton, told the Industrial Welfare Society conference last week that at the outbreak of war about 1500 factories had canteens, but, to-day, the figure was 9000.

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users during the four weeks ending August 28.

The word "research" is apt to strike terror into the British business man, said Sir Roy Fedden at a meeting of the Engineering Industries Association last week. This apathy and fear was due, he thought, to ignorance and lack of education. Stressing the need for intensified research, he mentioned that America had over 2000 laboratories and 70,000 research workers.

Special grade arsenic (arsenious oxide) has been allocated by the Ministry of Supply for rat-control, as much of the chemical ordinarily available has proved useless for the purpose. Coloured with chlor-azol blue, in accordance with the Poisons (Colouring) Rules, it can be obtained only from one or other of the eleven firms comprising Arsenic Distributors, Ltd.

Foreign News

The American Chemical Society will hold its next meeting in Pittsburgh from September 6-10.

Cotton seed from Uganda is now being used as fuel instead of coal by several East African factories. It is also used as fertiliser on tea, coffee, rubber, and sugar plantations.

Two wood distillation plants in Sweden have been expanded by the State-owned wood company formed early in 1942, and a plant for the recovery of by-products has been added to the sulphate factory at Karlsborg.

Kali-Chemie A.G. reports that sales in the first half of 1943 showed a considerable rise. The "still existing" plants are to work more intensively and the basis of production is to be extended.

The important French combine, Kuhlmann, has become an I.G. Farbenindustrie shareholder, as the annual report for 1942 reveals. The I.G. shares have been acquired in connection with the Francolor transaction and as a result of the I.G. capital increase last year. The new interest in the German chemical combine explains the increase in share holdings in the Kuhlmann balance-sheet from 131 to 182 million francs in 1942. The output last year was slightly higher than that of 1941.

Conductive rubber containers, used to handle explosives in munitions plants without danger of either static or mechanical sparks, are now being produced of synthetic rubber by the U.S. Rubber Co.

Drug exports from Hungary are said to be now at the rate of 1000 tons per annum. Hungary is the leading producer of medicinal herbs in central Europe and sends large quantities to Germany, Italy, Switzerland, and Sweden.

The Philadelphia firm of Röhm and Haas, are constructing their second acrylonitrile plant. The completion of this $300,000 plant will bring the number of American factories producing this chemical, which is an essential constituent of Buna-N synthetic rubbers, up to four.

Aluminium sulphate recently came under Government control in India with the introduction of the Sulphate of Alumina Control Order, 1943. Now no person is allowed to sell, acquire or use this chemical without the permission of the Central Government or its officers.

Sniace, the Spanish firm in which Snia Viscosa is interested, hopes to start making cellulose in its Torrelavega plant from September onwards. The capital will be raised from 90 to 150 million pesetas. Virtually, all the machinery is reported to have arrived by now from Sweden and Italy.

A Central Association of Chemical Industry has been formed in Finland in order to support research and promote the production of chemicals from indigenous raw materials. The members of the new association include 25 manufacturing firms and two research institutes.

Mr. Jesse Jones, U.S. Secretary of Commerce, said in a broadcast last week that his Government had built and owned nine aluminium plants with a total annual capacity of 1,200,000,000 lb. In magnesium and synthetic rubber plants it had invested $430,000,000 and $625,000,000.

Chemical and explosives factories in Canada cover an area equal to that occupied by the city of Montreal, said the Hon. C. D. Howe, Minister of Munitions and Supply recently. Production of chemicals and explosives is supervised by Allied War Supplies, Ltd. The Crown company controls 40 different projects, of which 34 have come into operation

Tanks of heat-treated plate glass are being made in America for use in the chemical, textile, photographic and electroplating industries. The heat treatment gives the tanks a physical strength four or five times greater than that of ordinary plate glass. The glass, marketed by Pittsburgh Plate Glass Co., withstands a continuous temperature of 340° C. and an instantaneous thermal shock of 200-250° C.

British Industrial Plastics, Ltd., have entered into an agreement with Elliotts and Australian Drug Proprietary, Ltd., for the formation of a company to be called Beetle Elliott Proprietary, Ltd., for the manufacture and sale in Australasia of beetle resins and moulding powders.

The Soviet Union has 2,000,000 acres of the rubber-dandelion, kok-saghyz, under cultivation. Trials with this plant are proceeding in America, and on one experimental farm rubber is being obtained at the rate of 50 lb. per acre. The United States have also planted 650 acres of goldenrod, which Edison considered a possible rubber-producer.

A/B Cellul, Stockholm, states in its first report (covering the period from November 6, 1941, to April 30, 1943) that operations began experimentally at the end of March last. The first spinning machine started working on April 1, 1943. The plant for the manufacture of sodium sulphate and nitric acid is nearing completion.

A new research laboratory of the Goodyear Tyre and Rubber Co., costing $1,325,000 and incorporating the latest equipment for investigating rubber and plastics, was opened at Akron, Ohio, a month ago. The ceremony included four symposia, at which leading American chemists discussed plastics, synthetic rubber, and the future of chemistry and of transportation.

Cobra venom, according to an account by B. N. Ghosh and D. K. Chaudhuri in the *Journal of the Indian Chemical Society* (1943, *20*, 1, p.22), contains a neurotoxin, which can be extracted as a preparation fifteen times more toxic than the crude venom. Chemically it resembles thymus histone, containing arginine, histidine and lysine in comparable proportions. It is without physiological action on the heart, but causes a cessation of breathing.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Satisfactions

LANGLEY ALLOYS, LTD. (Bucks.). (M.S., 7/8/43.) Satisfactions July 16, of mortgages registered May 6, June 10 (two), June 26, and July 23, 1942.

STARLINE VARNISH AND ENAMEL CO., LTD., Buckingham. (M.S., 7/8/43.) Satisfaction July 5, of charge registered October 15, 1931.

Company News

The Burmah Oil Co., Ltd., is paying a final dividend of 10 per cent., making 12½ per cent. for 1942 (same).

Sanitas Co., Ltd., announce a net profit to March of £96,981 (£90,234). The amount carried forward is £20,819 (£41,538).

Forster Balch & Co., Ltd., Penarth, have changed their name to Western Chemical Industries (Cardiff), Ltd

Van den Berghs and Jurgens, Ltd., report a profit for 1942 of £1,530,453 (£1,354,284), and have declared a tax free dividend of 8 per cent. (same) on the ordinary stock.

Sangers, Ltd., have maintained their net profit at £231,515 (£237,815) for the year ended April 30, and are paying a final ordinary dividend of 17½ per cent., making 22½ per cent. (20 per cent.). Dividends are also being paid on the 5½ per cent. and 7½ per cent. preference stock (same).

Harben's (Viscose Silk Manufacturers) are making a further arrears payment—for the year ended December 14, 1932—on the 8 per cent. first cumulative participating preference. The company also has in issue £10,000 of 8 per cent. second cumulative preference, which are in arrears as from April 30, 1930. No dividend has yet been paid on the ordinary shares.

New Companies Registered

Arkwright Chemicals, Ltd. (381,936).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and dealers in fine, synthetic and other chemicals, drugs, insecticides, oils and fats, perfumes, etc. Directors: G. C. Bancroft; A. J. Bancroft. Registered office: Ludgate House, 107/110 Fleet Street, E.C.4.

Polysh-All Co., Ltd. (381,177).—Private company. Capital: £2,000 in 1980 6 per cent. preference shares of £1 and 400 ordinary shares of 1s. each. Manufacturers of and dealers in cleansing powders and preparations, chemicals, etc. Directors: Sir Charles J. H. McRae; Lady Edith S. McRae; Mrs. M. I. Bennett; A. H. Thompson. Registered office: 129 Pancras Road, N.W.1.

John Harris Research, Ltd. (381,493).—Private company. Capital: £5000 in 5000 shares of £1 each. Industrial chemists in connection with tools, gauges and articles used in the motor and engineering trades, to undertake the chemical treatment of engineering tools, etc. Directors: H. G. C. Wilson; H. J. Haycock. Registered office: Stock Exchange Buildings, 33 Great Charles Street, Birmingham, 3.

Chemical and Allied Stocks and Shares

STOCK EXCHANGE markets have remained active, and further gains were shown among industrial shares, which continued to be influenced mainly by prevailing views of post-war prospects. Owing to the general willingness to take a long view, numerous shares have again moved higher, despite the small yields on the basis of last year's dividends. Turner & Newall, for instance, have risen further from 78s. 6d. to 79s. 3d. at the time of writing, Associated Cement from 63s. 6d. to 66s. 9d., Dunlop Rubber to 39s. 3d., and Lever & Unilever from 36s. to 36s. 6d. Textile shares were also prominent on after-war prospects; but the rise from 15s. 9d. to 18s. in Calico Printers ordinary also reflected hopes that results will permit a further payment in respect of preference dividend arrears this year. Bradford Dyers rose further from 19s. 6d. to 21s. 7½d. partly on the assumption that it may be possible to resume dividends on the ordinary shares in respect of the current year. A strong feature was provided by British Celanese, which, at the time of writing, have risen to 32s. 6d., compared with 28s. 6d. a week ago; sentiment was governed in a large measure by future possibilities attaching to the company's plastics subsidiary, which it was announced recently in Parliament is engaged on a new product for the Government. Courtaulds were also active, partly on plastics possibilities, and at 55s. were well maintained on balance. Erinoid 5s. shares changed hands up to 12s. British Industrial Plastics 2s. shares were active around 6s. Following their recent large advance, Thomas De La Rue reacted moderately and are £7½ at the time of writing.

Borax Consolidated moved up to 35s. 6d. Goodlass Wall 10s. ordinary were also influenced by hopes that after the war dividends may return to the pre-1939 level, and have changed hands up to 17s. Imperial Chemical at 39s. 1½d. were virtually unchanged as compared with a week ago, while B. Laporte were again 78s., and Burt Boulton 19s. Cellon 5s. ordinary transferred up to the higher level of 23s. 9d., Lawes Chemical 10s. ordinary marked 11s. 10½d. at one time, and British Drug Houses showed dealings up to 22s. 6d.

Richard Thomas 6s. 8d. ordinary remained under the influence of the dividend, while Stewarts & Lloyds were 52s., and Tube Investments 91s. 3d. Moreover, Allied Ironfounders showed recovery to 47s. 9d., while United Steel were better at 25s. Compared with a week ago, Babcock & Wilcox have risen from 47s. 3d. to 48s. 6d., and Guest Keen were 32s. 3d. Elsewhere, a rise from 17s. 3d. to 19s. 3d. was recorded in Amalgamated Metal shares, aided by the improved earning of the constituent companies. Gas Light & Coke ordinary moved up to 18s. 6d. on the resumption of interim dividends with a payment of 1½ per cent., which compares with only 1 per cent. for the whole of 1942. Consett Iron 6s. 8d. ordinary shares were firm at 7s. 9d. on the improvement in profits and the maintenance of the dividend at 7½ per cent. Compared with a week ago, General Refractories showed further im-

provement from 16s. to 16s. 4½d. Barry & Staines at 44s. 6d. held all but a small part of their recent rise, and Nairn & Greenwich were 68s. 9d.

Another share which moved up further despite the small current yield (last year's dividend was 4 per cent.) was Wall Paper deferred, which improved to 41s. 9d. Dividends prior to 1939 ranged up to 12½ per cent., and this is an instance where sentiment is influenced mainly by hopes of recovery in dividend payments after the war. Triplex Glass 10s. ordinary, which were also on a considerably higher dividend basis in pre-war years, have risen further to 36s. 6d. at the time of writing. Boots Drug were higher at 42s. 6d., as were Sangers at 22s. 10½d. Oil shares were better on balance; sentiment reflected satisfaction with the Burmah Oil dividend.

British Chemical Prices

Market Reports

RATHER quieter conditions are reported on the London general chemicals market this week and fresh inquiry is less in evidence, thanks to the influence of the holiday period. In the soda products section the demand for industrial refined nitrate of soda has been steady and no change in the price position falls to be recorded; fair deliveries of bicarbonate of soda and soda ash have been made against contracts. There has been no change in the position of chlorate of soda, and the undertone in this section remains extremely firm. In both nitrate and acetate of soda a moderate business is being arranged and values are well held. There is nothing fresh to report with regard to potash chemicals: the B.P. and commercial grades of permanganate of potash are in steady demand and inquiries for early delivery parcels are difficult to satisfy. Ready outlets are being found among the essential users for all the solid caustic potash that is being made available, and this applies also to bichromate of potash. Acid phosphate of potash continues firm and a fair inquiry is circulating. Among the miscellaneous chemicals, a fair volume of new business is reported in formaldehyde and peroxide of hydrogen, while alum lump has attracted a fair amount of attention at firm prices. Glycerine is being steadily absorbed as supplies come available, and offers of sulphur and arsenic are readily taken up. No change falls to be reported in the market for coal-tar products this week.

MANCHESTER.—Almost more than in any period this year, trading in chemical products on the Manchester market during the past week has been under the influence of holiday conditions, the closing of many works for the annual stoppages having resulted in numerous suspensions of contract deliveries, as well as in a slackening of new business. Most of the soda compounds, however, have been called for in fair quantities against commitments, while there has been a moderate movement of carbonate and bicarbonate of ammonia, alum and aluminium sulphate, and most of the acids. Potash chemicals are in short supply. Price conditions throughout the market are on a strong basis.

GLASGOW.—In the Scottish heavy chemical trade business in the home trade has now resumed its normal activities after the holidays. Export trade is still very limited. Prices remain very firm.

Price Changes

Ammonium Phosphate. Imported material, 11% nitrogen, 48% phosphoric acid, per ton d/d farmer's nearest station, in August, £19 17s. 6d. Increased charge of 2s. 6d. per month up to March, 1944.

Concentrated Fertilisers. Per ton d/d farmer's nearest station, in August: I.C.I. Type "Special No. 1," £14 4s. Increased charge of 2s. 6d. per month up to March, 1944; Type "Special No. 2," none available until January, 1944.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

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Vertical totally enclosed mild Steel STEAM JACKETED MIXER, 6 ft. 0 in. dia. by 8 ft. 6 in. deep; dished bottom and bolted-on dished cover; fitted vertical glanded agitating shaft overdriven through gearing from f. & l. pulleys; two sets of internal steam coils, manhole, sundry connections, etc.

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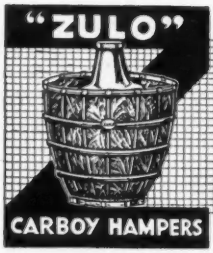

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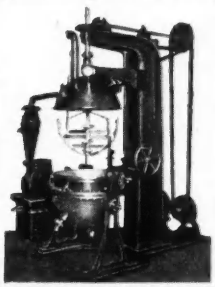

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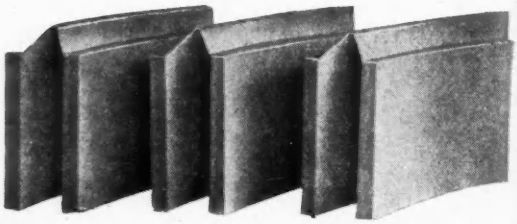

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